

## **Chih-Hung Chang**

### **PROFESSOR & ASSOCIATE HEAD of UNDERGRADUATE PROGRAMS**

School of Chemical, Biological and Environmental Engineering  
Oregon State University

#### **Director**

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### **EDUCATION**

- Ph.D. Chemical Engineering, University of Florida, 1999  
Thesis Advisor: Timothy J. Anderson  
B.S. Chemical Engineering, National Taiwan University, 1991

### **ACADEMIC POSITIONS**

- Associate Head of Undergraduate Programs, School of Chemical, Biological and Environmental Engineering, Oregon State University, 2020 - present
- Professor, School of Chemical, Biological and Environmental Engineering, Oregon State University, 2010 - present
- Director, Oregon Process Innovation Center, 2010-present
- Associate Professor, Department of Chemical Engineering, Oregon State University, 2006 - 2010
- Visiting Associate Professor, Department of Materials Science and Engineering, National Taiwan University, Apr 2008 – Sep 2008
- Assistant Professor, Department of Chemical Engineering, Oregon State University, 2000 - 2006
- Research Assistant, Department of Chemical Engineering, University of Florida, 1994-1999

### **NON-ACADEMIC POSITIONS**

- BOD Member, Pellucere Inc. (formerly CSD Nano), 2018-present
- Founder and Chief Science Officer, CSD Nano Inc., 2007-2018
- Founder & Chief Technology Advisor, Nanobits Inc., 2005-2009
- Research Engineer, Nan-ya plastics Co., 1993-1994
- Lieutenant, Republic of China Army, 1991-1993

### **RESEARCH INTERESTS**

- Thin Film Growth
- Thin Film Electronics
- Microreaction Technology

- Nanomaterials
- Solar Energy Conversion

## **AWARDS**

1. Fellow, National Academy of Inventors, 2020
2. Solar Proze Round 4 Set Winner, 2021
3. Solar Prize Round 4 Ready Winner, 2020
4. Winner, Arsenic Stage 1 Prize Competition, U.S. Bureau of Reclamation, 2017
5. Walmart Manufacturing Innovation Foundation Awardee. 2016, 2017
6. Faculty Innovator Award, OSU, 2015
7. Research Award, OSU College of Engineering, 2015
8. TechConnect National Innovation Award, 2015
9. SME “Innovations That Could Change the Way You Manufacture” Watch List for Microreactor-Assisted Nanomaterial Deposition, 2011
10. Sharp Laboratories of America Scholar, 2008
11. Best Poster Award, Symposium T, MRS 2007 Spring Meeting, San Francisco, 2007
12. Lab-to-Market Technology Disclosure Competition, 2005
13. W.M. Keck foundation awardees, 2004
14. National Science Foundation CAREER award, 2004
15. Best Poster Award, ASEE ChE Faculty Summer School, 2002
16. Intel Faculty Fellow, Intel Co., 2000 and 2001
17. Graduate Research Awards, American Vacuum Society, 1999
18. Scholarship for XVIIIth IUCr Congress and General Assembly, 1999
19. Scholarship for 1999 High Resolution Electron Microscopy Winter School, 1999
20. Scholarship for 7th ACA Summer School in Crystallography, 1998
21. College of Engineering Academic Excellence Awards, University of Florida, 1996, 1997, and 1999
22. International Student Academic Awards, University of Florida, 1995, 1996, and 1997
23. National Taiwan University Academic Awards, Taiwan ROC, 1989

## **Professional Activities**

Editor, IEEE J. Photovoltaics, June 2017 - present

Associate Editor, IEEE J. Photovoltaics, September 2016 – May 2017

Editorial Board Member, Nanomaterials, MDPI, 2010-present.

Editorial Board Member, Micromachines, MDPI, 2019-present

Editorial Board member, Journal of Materials, Hindawi, July 2012 – July 2017

**Board membership:** Pacific Northwest Chapter American Vacuum Society

**10. Professional development activities:**

National Effective Teaching Institutes NETI-1B, July 29-31 Workshop, Philadelphia, PA  
NSF I-CORPs

Launch program, OSU Advantage Accelerator 2018

Lens of the Market (LoM) program, R2I2S NSF NRT IGE at OSU

**Professional membership:** American Institute of Chemical Engineers, The Electrochemical Society, American Vacuum Society, Institute of Electrical and Electronics Engineers, American Chemical Society, Material Research Society, American Association for the Advancement of Science, Microscopy Society of American, Society of Information Display.

**SCHOLARSHIP AND CREATIVE ACTIVITY**

*Summary of Scholarship and Research*

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<b>Scholarship Summary</b>	
<i>Refereed Publications</i> (153 in print)	153
<i>Non-Referred Publications</i> (8 invited contributions)	46
<i>Technical Presentations</i> (83 invited presentations)	247
<i>Books &amp; Book Chapters</i>	8
<i>Inventions and Patents</i> (15 issued patents, 3 pending patents, 37 invention disclosures)	44

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<b>Research Summary</b>	
<i>Graduate Research</i>	
Postdoctoral Scholars trained	7
Graduate students trained	
Ph.D. degrees (17 awarded 4 current )	21
M.S. degrees (23 awarded 3 current)	26
Honor BS (4 awarded 1 current)	5
<i>Grants</i>	
External Competitive Grant	62
Industrial Grant	19

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OSU Internal Competitive

7

Total awards

\$ 17.1 million

## Publication List (Chih-Hung Chang)

### H-Index (Google Scholar)

	All	Since 2016
Citations	5972	2949
h-index	44	30
i10-index	109	81

### Journal and Refereed Publications

1. Yajuan He, Yu Cao, Hyun-jun Hwang, Harish Devaraj, Sarath M. Vega Gutierrez, Shujie Li, Hsiou-Lien Chen, Seri C. Robinson, Chih-hung Chang, Rajiv Malhotra, Inkjet Printing and In-situ Crystallization of Biopigments for Eco-Friendly and Energy-Efficient Fabric Coloration, *Int. J. of Precis. Eng. and Manuf.-Green Tech.* (2021).  
<https://doi.org/10.1007/s40684-021-00360-5>.
2. Liam Gillan, Shujie Li, Chih-Hung Chang, Ari Alastalo, Jaakko Leppäniemi, Inkjet-Printed Ternary Oxide Dielectric and Doped Interface Layer for Metal Oxide Thin-Film Transistors with Low Voltage Operation, *Advanced Materials Interfaces*, under review
3. Yujun He, Jie Liu, Shi-Joon Sung, Chih-hung Chang, Downshifting and antireflective thin films for solar module power enhancement, *Materials and Design*  
<https://doi.org/10.1016/j.matdes.2021.109454>.
4. Lim Sangwoo Kim, Taehyeon, Son, Changjin, Lee, Junwoo, Oh, Eunseok, Li, Shujie, Chang, Chih-Hung, Interfacial ZnS passivation for improvement of transparent ZnO/CuI diode characteristics, *Applied Surface Science* 536 (15), 147645 (2021)
5. Shujie Li, Alex Kosek, Mohammad Naim Jahangir, Rajiv Malhotra, Chih-Hung Chang. Inkjet Printing of Perovskites for Breaking Performance - Temperature Tradeoffs in Fabric - Based Thermistors, *Advanced Functional Materials*, 2006273 (2020)
6. Chang-Ho Choi, Yeongwon Kwak, Rajiv Malhotra, Chih-hung Chang, Microfluidics for Two-Dimensional Nanosheets: A Mini Review, *Processes* 8(9), 1067 (2020)
7. Kim, K., Guo, Q., Tang, L., Zhu, L., Pan, C., Chang, C., Razink, J., Lerner, M.M., Fang, C. and Ji, X., Reversible insertion of Mg - Cl superhalides in graphite as a cathode for aqueous dual - ion battery. *Angew. Chem. Int. Ed.* 132 (45), 20096-20100  
[doi:10.1002/anie.202009172](https://doi.org/10.1002/anie.202009172) (2020)
8. Y He, KJ Kim, C Chang, "Segmented Microfluidic Flow Reactors for Nanomaterial Synthesis," *Nanomaterials* 10 (7), 1421 (2020)

9. Milad Ghayoor, Kijoon Lee, Yujuan He, Chih-hung Chang, Brian K Paul, Somayeh Pasebani, "Selective laser melting of austenitic oxide dispersion strengthened steel: Processing, microstructural evolution and strengthening mechanisms" *Materials Science and Engineering: A*, 139532 (2020)
10. Y Zhang, CH Chang, "Metal-Organic Framework Thin Films: Fabrication, Modification, and Patterning" *Processes* 8 (3), 377 (2020)
11. B.K. Paul, K. Lee, Y. He, M. Ghayoor, C. Chang, S. Pasebani "Oxide dispersion strengthened 304 L stainless steel produced by ink jetting and laser powder bed fusion" *CIRP Annals* 69 (1), 193-196 (2020)
12. M Ghayoor, K Lee, Y He, C Chang, BK Paul, S Pasebani "Selective laser melting of 304L stainless steel: Role of volumetric energy density on the microstructure, texture and mechanical properties" *Additive Manufacturing* 32, 101011 (2020)
13. Yujuan He, Zhong Chen and Chih-hung Chang, "Hydrothermal synthesis and site symmetry tuning of polycrystalline YVO<sub>4</sub>:Eu nanoparticles via a continuous-flow microreactor" *Nanotechnology* **31** 235603 (2020)
14. Yujing Zhang, Xinyuan Chong, Hao Sun, Muaz M. Kedir, Ki-Joong Kim, Paul R. Ohodnicki, Alan X. Wang, and Chih-hung Chang, "Nanostructured Copper Sulfide Thin Film via a Spatial Successive Ionic Layer Adsorption and Reaction Process Showing Significant Surface-Enhanced Infrared Absorption of CO<sub>2</sub>" *Journal of Materials Chemistry C* 8 (9), 3069-3078 (2020)
15. Ho Young Jun, Chih-Hung Chang, Kwang-Soon Ahn, Si Ok Ryu and Chang-Ho Choi, "Microfluidics-enabled Rational Design for Ag-ZnO Nanocomposite Films for Enhanced Photoelectrochemical Performance" *CrystEngComm* 22 (4), 646-653 (2020) (**Journal Cover**)
16. Arni Sturluson, Rachel Sousa, Yujing Zhang, Melanie T. Huynh, Caleb Laird, Arthur H. P. York, Carson Silsby, Chih-Hung Chang, and Cory M. Simon, "Curating metal-organic frameworks to compose robust gas sensor arrays in dilute conditions" *ACS Applied Materials & Interfaces* 12 (5), 6546-6564 (2020)
17. Hyun-Jun Hwang, Cheng Zeng, Changqing Pan, Michael Dexter, Rajiv Malhotra, Chih-hung Chang, "Tuning Electronic and Photocatalytic Properties in Pulsed Light Synthesis of Cu<sub>2</sub>ZnSnS<sub>4</sub> films from CuS-ZnS-SnS Nanoparticles" *Materials Research Bulletin*, 122, 110645 (2019)
18. Alvin Chang, Yujuan He, Maria Torres-Arango, Maoyu Wang, Yang Ren, Zhenxing Feng, Chih-hung Chang and Konstantinos A. Sierros, "On the unusual amber coloration of nanoporous sol-gel processed Al-doped silica glass: An experimental study," *Scientific Reports* volume 9, Article number: 12474 (2019)
19. Yu-Wei Su, Brian K Paul, Chih-hung Chang "Investigation of CdS nanoparticles formation and deposition by the continuous flow microreactor" *Applied Surface Science* 472, 158-164 (2019)
20. Sarath M Vega Gutierrez, Yujuan He, Yu Cao, Derek Stone, Zielle Walsh, Rajiv Malhotra, Hsiou-Lien Chen, Chih-Hung Chang, Seri C Robinson "Coatings Feasibility and Surface

- Evaluation of the Pigment from *Scytalidium cuboideum* for Inkjet Printing on Textiles, *Coatings* (2019) 9(4), 266; <https://doi.org/10.3390/coatings9040266>
21. Venkata Rajesh Saranam, Chih-Hung Chang and Brian K. Paul, A Foam-Core Meniscus Coating Process for Retrofit Anti-Reflective Coatings, *J. Micro Nano-Manuf* 7(3), 031003 (2019).
  22. Michael Dexter, Keri Rickman, Changqing Pan, Chih-hung Chang, Rajiv Malhotra, Intense Pulsed Light unprinting for reducing life-cycle stages in recycling of coated printing paper, *Journal of Cleaner Production*, Volume 232, 20 September 2019, Pages 274-284
  23. Hyun-Jun Hwang, Harish Devaraj, Chen Yang, Zhongwei Gao, Chih-hung Chang, Howon Lee & Rajiv Malhotra “Rapid Pulsed Light Sintering of Silver Nanowires on Woven Polyester for personal thermal management with enhanced performance, durability and cost-effectiveness” *Scientific Reports* 8, Article number: 17159 (2018).
  24. Dick Chiu, Yujuan He, Zhongwei Gao, Cassandra Remple, Chih-Hung Chang, “Growth Kinetics of ZnS Thin Films from a High-Rate Chemical Bath Deposition with Trisodium-Nitrioltriacetate Complexing,” *ECS Journal of Solid State Science and Technology*, 7(11) (2018) 615-623.
  25. Michael Dexter, Andrew Pfau, Zhongwei Gao, Gregory S Herman, Chih-hung Chang, Rajiv Malhotra, “Modeling nanoscale temperature gradients and conductivity evolution in pulsed light sintering of silver nanowire networks,” *Nanotechnology* 29(50) (2018) 505205.
  26. Ki-Joong Kim, Peter B. Kreider, Ho-Geun Ahn, Chih-Hung Chang, Characterization of Cotton Ball-like Au/ZnO Photocatalyst Synthesized in a Micro-reactor, *Micromachines* 2018, 9 (7), 322.
  27. Ki-Joong Kim, Yujing Zhang, Peter B. Kreider, Xinyuan Chong, Alan X. Wang, Paul R. Ohodnicki Jr., John P. Baltrus, Chih-Hung Chang, “Nucleation and growth of oriented metal-organic framework thin films on an oxide surface,” *Thin Solid Films* 659 (2018) 24-35.
  28. Chang-Ho Choi, Shankar Krishnan, Ward TeGrotenhuis and Chih-Hung Chang, Capillary Rise of Nanostructured Microwicks, *Micromachines* 2018, 9, 153; doi:10.3390/mi9040153
  29. G.H. Albuquerque, K. Kim, J. Lopez, A. Devaraj, S. Manandhar, Y. Liu, J. Guo. C.Chang, G. Herman, “Multimodal characterization of solution-processed Cu<sub>3</sub>SbS<sub>4</sub> absorbers for thin film solar cells”, *J. Mater. Chem. A*. 2018 6 (18), 8682-8692 DOI: 10.1039/C8TA00001H.
  30. Xinyuan Chong, Yujing Zhang, Erwen Li, Ki-Joong Kim, Paul R Ohodnicki, Chih-hung Chang, Alan X Wang, “Surface-Enhanced Infrared Absorption: Pushing the Frontier for On-Chip Gas Sensing,” *ACS Sensors* 2018 3 (1), 230-238 DOI: 10.1021/acssensors.7b00891
  31. Yu-Wei Su, Brian Paul. Chih-Hung Chang, “Investigation of CdS nanoparticles formation and deposition by the continuous flow microreactor,” March 2018 *Applied Surface Science* DOI10.1016/j.apsusc.2018.02.157

32. M Dexter, Z Gao, S Bansal, CH Chang, R Malhotra, "Temperature, Crystalline Phase and Influence of Substrate Properties in Intense Pulsed Light Sintering of Copper Sulfide Nanoparticle Thin Films," *Scientific Reports* 8 (1), 2201 (2018).
33. Chong, Xinyuan; Kim, Ki-Joong; Zhang, Yujing; Li, Erwen; Ohodnicki, Paul; Chang, Chih-Hung; Wang, Alan "Plasmonic nano-patch array with integrated metal-organic framework for enhanced infrared absorption gas sensing," *Nanotechnology* 30 28(26) doi: 10.1088/1361-6528/aa7433. (2017).
34. He, Yujuan, Ki-Joong Kim, Chih-hung Chang, "Continuous, size and shape-control synthesis of hollow silica nanoparticles enabled by a microreactor-assisted rapid mixing process," *Nanotechnology*, 28 235602 (2017).
35. Kim, Ki-Joong, Changqing Pan, Shalu Bansal, Rajiv Malhotra, Dae-Hwan Kim, and Chih-Hung Chang. "Scalably synthesized environmentally benign, aqueous-based binary nanoparticle inks for  $\text{Cu}_2\text{ZnSn}(\text{S},\text{Se})_4$  photovoltaic cells achieving over 9% efficient." *Sustainable Energy & Fuels*, 1(2), DOI: 10.1039/c6se00035e (2017). **(Journal Cover)**
36. Choi, Chang-Ho, Elizabeth Allan-Cole, and Chih-Hung Chang. "Visible to Infrared Plasmonic Absorption from Silver Nanostructures Enabled by Microreactor-Assisted Solution Deposition." *CrystEngComm*, 19 (9), 1265-1272 (2017). **(Journal Cover)**
37. Choi, Chang-Ho, Janssen Ballard Levin, and Chih-Hung Chang. "Continuous formation of a seed layer and vertical ZnO nanowire arrays enabled by tailored reaction kinetics in a microreactor." *CrystEngComm* 18 (44), 8645-8652 (2016).
38. Choi, Chang-Ho, Jenna Y. Gorecki, Zhen Fang, Marshall Allen, Shujie Li, Liang-Yu Lin, Chun-Cheng Cheng, and Chih-Hung Chang. "Low-temperature, inkjet printed p-type copper (I) iodide thin film transistors." *Journal of Materials Chemistry C* 4, no. 43 (2016): 10309-10314.
39. Choi, Chang-Ho, Michele David, Zhongwei Gao, Alvin Chang, Marshall Allen, Hailei Wang, and Chih-Hung Chang. "Large-scale Generation of Patterned Bubble Arrays on Printed Bi-functional Boiling Surfaces." *Scientific Reports* volume6, Article number: 23760 (2016) doi:10.1038/srep23760
40. Vas-Umnuay, Paravee, Ki-Joong Kim, and Chih-Hung Chang. "Growth kinetics of copper sulfide thin films by photochemical deposition." *CrystEngComm* 18, no. 35 (2016): 6748-6758.
41. Chong, Xinyuan, Ki-Joong Kim, Erwen Li, Yujing Zhang, Paul R. Ohodnicki, Chih-Hung Chang, and Alan X. Wang. "Near-infrared absorption gas sensing with metal-organic framework on optical fibers." *Sensors and Actuators B: Chemical* 232 (2016): 43-51.
42. MacNeill, William, Chang-Ho Choi, Chih-Hung Chang, and Rajiv Malhotra. "On the self-damping nature of densification in photonic sintering of nanoparticles." *Scientific reports* 5 (2015).
43. Chong, Xinyuan, Ki-Joong Kim, Paul R. Ohodnicki, Erwen Li, Chih-Hung Chang, and Alan X. Wang. "Ultrashort Near-Infrared Fiber-Optic Sensors for Carbon Dioxide Detection." *IEEE Sensors Journal* 15, no. 9 (2015): 5327-5332.

44. Palanisamy, Barath, Brian Paul, and Chih-Hung Chang. "The synthesis of cadmium sulfide nanoplatelets using a novel continuous flow sonochemical reactor." *Ultrasonics sonochemistry* 26 (2015): 452-460.
45. Park, Seon Young, Ho Young Jun, Chih Hung Chang, and Si Ok Ryu. "Influence of pH and Annealing Temperature on Properties of ZnS (O, OH) Thin Films Deposited by Continuous Flow Microreactor Method." *Journal of Nanoelectronics and Optoelectronics* 10, no. 4 (2015): 588-594.
46. Choi, Chang-Ho, Elizabeth Allan-Cole, and Chih-Hung Chang. "Room temperature fabrication and patterning of highly conductive silver features using in situ reactive inks by microreactor-assisted printing." *Journal of Materials Chemistry C* 3, no. 28 (2015): 7262-7266. **(Journal Cover)**
47. Chang, Chih-Hung, Wei Wang, Xiulei David Ji, and Paul J. Benning. "Preface to the Focus Issue on Printable Functional Materials for Electronics and Energy Applications." *ECS Journal of Solid State Science and Technology* 4, no. 4 (2015): Y5-Y5.
48. Choi, Chang-Ho, Yu-Wei Su, Liang-Yu Lin, Chun-Cheng Cheng, and Chih-Hung Chang. "The Effects of Gallium on Solution-derived Indium Oxide-based Thin Film Transistors Manufactured on Display Glass." *RSC Adv.* 5, no. 114 (2015): 93779-3785.
49. Vas-Umnuay, Paravee, Ki-Joong Kim, Dae-Hwan Kim, and Chih-Hung Chang. "Conformal growth of copper sulfide thin films on highly textured surface via microreactor-assisted solution deposition." *CrystEngComm* 17, no. 14 (2015): 2827-2836.
50. Han, Seung-Yeol, Changqing Pan, Dae-Hwan Kim, and Chih-Hung Chang. "Low-cost & low-temperature curable solution-processed silica-based nanostructured antireflective coatings on CuIn<sub>1-x</sub>Ga<sub>x</sub>Se<sub>2</sub> thin film solar cells." *RSC Advances* 5 (2015): 24712-24717.
51. Choi, Chang-Ho, Liang-Yu Lin, Chun-Cheng Cheng, and Chih-Hung Chang. "Printed Oxide Thin Film Transistors: A Mini Review." *ECS Journal of Solid State Science and Technology* 4, no. 4 (2015): P3044-P3051.
52. Kim, Ki-Joong, Xinyuan Chong, Peter B. Kreider, Guoheng Ma, Paul R. Ohodnicki, John P. Baltrus, Alan X. Wang, and Chih-Hung Chang. "Plasmonics-enhanced metal-organic framework nanoporous films for highly sensitive near-infrared absorption." *Journal of Materials Chemistry C* 3, no. 12 (2015): 2763-2767.
53. Xing, Zhenyu, Bao Wang, Wenyang Gao, Changqing Pan, Joshua K. Halsted, Elliot S. Chong, Jun Lu et al. "Reducing CO<sub>2</sub> to dense nanoporous graphene by Mg/Zn for high power electrochemical capacitors." *Nano Energy* 11 (2015): 600-610.
54. Choi, Chang-Ho, Seung-Yeol Han, Yu-Wei Su, Zhen Fang, Liang-Yu Lin, Chun-Cheng Cheng, and Chih-Hung Chang. "Fabrication of high-performance, low-temperature solution processed amorphous indium oxide thin-film transistors using a volatile nitrate precursor." *Journal of Materials Chemistry C* 3, no. 4 (2015): 854-860.
55. Kim, Ki-Joong, Chih-Hung Chang, and Ho-Geun Ahn. "The Effect of Zinc Oxide Addition to Alumina-Supported Gold Catalyst in Low Temperature Carbon Monoxide Oxidation." *Journal of nanoscience and nanotechnology* 15, no. 1 (2015): 660-664.



56. Kim, Ki-Joong, Richard P. Oleksak, Eric B. Hostetler, Daniel A. Peterson, Padmavathi Chandran, David M. Schut, Brian K. Paul, Gregory S. Herman, and Chih-Hung Chang. "Continuous Microwave-Assisted Gas-Liquid Segmented Flow Reactor for Controlled Nucleation and Growth of Nanocrystals." *Crystal Growth & Design* 14, no. 11 (2014): 5349-5355.
57. Choi, Chang-Ho, and Chih-Hung Chang. "Aqueous synthesis of tailored ZnO nanocrystals, nanocrystal assemblies, and nanostructured films by physical means enabled by a continuous flow microreactor." *Crystal Growth & Design* 14, no. 9 (2014): 4759-4767.
58. Choi, Chang-Ho, Brian K. Paul, and Chih-Hung Chang. "Microreactor-Assisted Solution Deposition for Compound Semiconductor Thin Films." *Processes* 2, no. 2 (2014): 441-465.
59. Hwang, Yeon, Doh-Hyung Riu, Ki-Joong Kim, and Chih-Hung Chang. "Porous SiOC beads by freeze-drying polycarbosilane emulsions." *Materials Letters* 131 (2014): 174-177.
60. Hostetler, Eric B., Ki-Joong Kim, Richard P. Oleksak, Robert C. Fitzmorris, Daniel A. Peterson, Padmavathi Chandran, Chih-Hung Chang, Brian K. Paul, David M. Schut, and Gregory S. Herman. "Synthesis of colloidal PbSe nanoparticles using a microwave-assisted segmented flow reactor." *Materials Letters* 128 (2014): 54-59.
61. Kim, Ki-Joong, Richard P. Oleksak, Changqing Pan, Michael W. Knapp, Peter B. Kreider, Gregory S. Herman, and Chih-Hung Chang. "Continuous synthesis of colloidal chalcopyrite copper indium diselenide nanocrystal inks." *RSC Advances* 4, no. 32 (2014): 16418-16424.
62. Kreider, Peter B., Ki-Joong Kim, and Chih-Hung Chang. "Two-step continuous-flow synthesis of CuInSe<sub>2</sub> nanoparticles in a solar microreactor." *RSC Advances* 4, no. 27 (2014): 13827-13830.
63. Han, Katherine, and Chih-Hung Chang. "Numerical modeling of sub-wavelength anti-reflective structures for solar module applications." *Nanomaterials* 4, no. 1 (2014): 87-128.
64. Han, Katherine, Hai-Yue Han, James Stack Jr, and Chih-Hung Chang. "Finite difference time domain modeling of subwavelength-structured anti-reflective coatings." *Applied Computational Electromagnetics Society* 29(1), 1-8 (2014).
65. Chang, Chih-Hung, and Brian K. Paul. "Microreactor-Assisted Nanomaterial Processing: Scaling by an Equal up and Equal down Approach." *Chemical Engineering & Process Techniques* 1, no.3 (2013): 1015.
66. Kim, Ki-Joong, Yong Jun Li, Peter B. Kreider, Chih-Hung Chang, Nick Wannemacher, Praveen K. Thallapally, and Ho-Geun Ahn. "High-rate synthesis of Cu-BTC metal-organic frameworks." *Chemical Communications* 49, no. 98 (2013): 11518-11520.
67. Ramprasad, Sudhir, Yu-Wei Su, Chih-Hung Chang, Brian K. Paul, and Daniel R. Palo. "Continuous microreactor-assisted solution deposition for scalable production of CdS films." *ECS Journal of Solid State Science and Technology* 2, no. 9 (2013): P333-P337.

68. Kim, Ki-Joong, Peter B. Kreider, Changho Choi, Chih-Hung Chang, and Ho-Geun Ahn. "Visible-light-sensitive Na-doped p-type flower-like ZnO photocatalysts synthesized via a continuous flow microreactor." *RSC Advances* 3, no. 31 (2013): 12702-12710.
69. Vas-Umnuay, Paravee, and Chih-Hung Chang. "Growth kinetics of copper sulfide thin films by chemical bath deposition." *ECS Journal of Solid State Science and Technology* 2, no. 4 (2013): P120-P129.
70. Kim, Ki-Joong, Peter B. Kreider, Chih-Hung Chang, Chul-Min Park, and Ho-Geun Ahn. "Visible-light-sensitive nanoscale Au-ZnO photocatalysts." *Journal of nanoparticle research* 15, no. 5 (2013): 1-11.
71. Su, Yu-Wei, Sudhir Ramprasad, Seung-Yeol Han, Wei Wang, Si-Ok Ryu, Daniel R. Palo, Brian K. Paul, and Chih-Hung Chang. "Dense CdS thin films on fluorine-doped tin oxide coated glass by high-rate microreactor-assisted solution deposition." *Thin Solid Films* 532 (2013): 16-21.
72. Choi, Chang-Ho, Yu-Wei Su, and Chih-Hung Chang. "Effects of fluid flow on the growth and assembly of ZnO nanocrystals in a continuous flow microreactor." *CrystEngComm* 15, no. 17 (2013): 3326-3333.
73. Murali, Santosh, Jaana S. Rajachidambaram, Seung-Yeol Han, Chih-Hung Chang, Gregory S. Herman, and John F. Conley. "Resistive switching in zinc-tin-oxide." *Solid-State Electronics* 79 (2013): 248-252.
74. Tseng, Chih Heng T., Brian K. Paul, Chih-Hung Chang, and Mark H. Engelhard. "Continuous precipitation of ceria nanoparticles from a continuous flow micromixer." *The International Journal of Advanced Manufacturing Technology* 64, no. 1-4 (2013): 579-586.
75. Paul, B. K., C. L. Hires, Y-W. Su, C-H. Chang, S. Ramprasad, and D. Palo. "A uniform residence time flow cell for the microreactor-assisted solution deposition of CdS on an FTO-glass substrate." *Crystal Growth & Design* 12, no. 11 (2012): 5320-5328.
76. Han, Seung-Yeol, Brian K. Paul, and Chih-Hung Chang. "Nanostructured ZnO as biomimetic anti-reflective coatings on textured silicon using a continuous solution process." *Journal of Materials Chemistry* 22, no. 43 (2012): 22906-22912.
77. Jin, Hyung Dae, and Chih-Hung Chang. "Synthesis of CuInSe<sub>2</sub> nanocrystals using a continuous hot-injection microreactor." *Journal of Nanoparticle Research* 14, no. 10 (2012): 1-9.
78. Flynn, Brendan, Wei Wang, Chih-hung Chang, and Gregory S. Herman. "Microwave assisted synthesis of Cu<sub>2</sub>ZnSnS<sub>4</sub> colloidal nanoparticle inks." *Physica Status Solidi (a)* 209, no. 11 (2012): 2186-2194.
79. Ramprasad, Sudhir, Yu-Wei Su, Chih-Hung Chang, Brian K. Paul, and Daniel R. Palo. "Cadmium sulfide thin film deposition: A parametric study using microreactor-assisted chemical solution deposition." *Solar Energy Materials and Solar Cells* 96 (2012): 77-85.
80. Wang, Wei, Seung-Yeol Han, Shi-Joon Sung, Dae-Hwan Kim, and Chih-Hung Chang. "8.01% CuInGaSe<sub>2</sub> solar cells fabricated by air-stable low-cost inks." *Physical Chemistry Chemical Physics* 14, no. 31 (2012): 11154-11159.

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83. Lee, Jin Young, Mi Sun Park, Tae Jin Lee, Sang Ouk Ryu, Chih Hung Chang, and Si Ok Ryu. "Synthesis of CdTe thin films for solar cell using solution-based deposition methods at low temperature." *Molecular Crystals and Liquid Crystals* 551, no. 1 (2011): 181-190.
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### Non-Refereed Conference Publications

1. Xinyuan Chong, Yujing Zhang, Ki-Joong Kim, Erwen Li, Paul R Ohodnicki, Chih-Hung Chang, Alan X Wang, "Nan Nano-membrane based Plasmonic Devices for Surface-Enhanced Infrared Absorption Gas Sensing" Conference on Lasers and Electro-Optics, OSA Technical Digest (online) (Optical Society of America, 2018), paper JTh2A.193.
2. Xinyuan Chong; Erwen Li; Ki-Joong Kim; Yujing Zhang; Paul R. Ohodnicki; Chih-Hung Chang; Alan X. Wang On-chip surface-enhanced infrared absorption for gas sensing ROCEEDINGS VOLUME 10536 SPIE OPTO | 27 JANUARY - 1 FEBRUARY 2018 Smart Photonic and Optoelectronic Integrated Circuits XX.
3. Shalu Bansal, Zhongwei Gao, Chih-hung Chang and Rajiv Malhotra, "Rapid Intense Pulse Light Sintering of Copper Sulphide Nanoparticle Films" Paper No. MSEC2017-2739, pp. V001T02A067; 9 pages doi:10.1115/MSEC2017-2739 ASME 2017 12th International Manufacturing Science and Engineering Conference collocated with the JSME/ASME 2017 6th International Conference on Materials and Processing Volume 1: Processes Los Angeles, California, USA, June 4–8, 2017 Conference Sponsors: Manufacturing Engineering Division ISBN: 978-0-7918-5072-5
4. Plasmonic Nanoantenna Array with Single-Chip Integrated Metal-Organic Framework for Infrared Absorption Gas Sensing Xinyuan Chong, Ki-Joong Kim, Erwen Li, Yujing Zhang, Paul Ohodnicki, Chih-Hung Chang, Alan X Wang Publication date 2016/10/17 Conference Frontiers in Optics Pages JW4A. 137 Publisher Optical Society of America.
5. Xinyuan Chong, Ki-Joong Kim, Erwen Li, Yujing Zhang, Paul R Ohodnicki, Chih-Hung Chang, Alan X Wang Plasmonic nanoantenna array with single-chip integrated metal-organic framework for infrared absorption CO<sub>2</sub> sensing 2017 Conference on Lasers and Electro-Optics (CLEO).
6. Xinyuan Chong, Ki-Joong Kim, Erwen Li, Yujing Zhang, Paul Ohodnicki, Chih-Hung Chang, and Alan X. Wang Plasmonic Nanoantenna Array with Single-Chip Integrated Metal-Organic Framework for Infrared Absorption Gas Sensing Frontiers in Optics 2016 OSA Technical Digest (online) (Optical Society of America, 2016), paper JW4A.137.
7. Xinyuan Chong, Ki-Joong Kim, Erwen Li, Yujing Zhang, Paul R Ohodnicki, Chih-Hung Chang, Alan X Wang "Ultra-sensitive CO<sub>2</sub> fiber-optic sensors enhanced by metal-organic framework film" 2016/6/5 Conference Lasers and Electro-Optics (CLEO), 2016. IEEE.

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9. Shalu Bansal, Chih-Hung Chang, Rajiv Malhotra, "The Coupling Between Densification and Optical Heating in Intense Pulsed Light Sintering of Silver Nanoparticles" 2016/6/27 Conference ASME 2016 11th International Manufacturing Science and Engineering Conference Pages V001T02A082-V001T02A082 American Society of Mechanical Engineers.
10. Choi, Chang-Ho, Seung-Yeol Han, Jenna Y. Gorecki, Liang-Yu Lin, Chun-Cheng Cheng, and Chih-Hung Chang. "Printed Metal Oxide Transistors." *SID Symposium Digest of Technical Papers* 47, no. 1, (2016): 876–879. **(Invited Paper)**
11. Choi, Chang-Ho, Zhen Fang, Jenna Gorecki, Marshall Allen, Chih-hung Chang, Liang-Yu Lin, and Chun-Cheng Cheng. "Printed p-type CuI TFTs." In *NIP & Digital Fabrication Conference 2015*, no. 1 (2015): 219-220. Society for Imaging Science and Technology.
12. He, Yujuan, Harrison R. Holzgang, Ki-Joong Kim, and Chih-Hung Chang. "Inkjet Printed Hollow Silica Nanoparticles for Anti-Reflective Coatings." In *NIP & Digital Fabrication Conference 2015*, no. 1 (2015): 486-489. Society for Imaging Science and Technology.
13. Choi, Chang-Ho, Jenna Gorecki, Zhen Fang, Marshall Allen, Chih-Hung Chang, Liang-Yu Lin, and Chun-Cheng Cheng. "Inkjet Printed P-type Semiconductors and Thin Film Transistors." *International Display Manufacturing Conference & 3D Systems and Applications* (2015). IDMC'15 S19-1. **(Invited Paper)**
14. Su, Yu-Wei, Sudhir Ramprasad, Seung-Yeol Han, Wei Wang, Si-Ok Ryu, Daniel R. Palo, Brian K. Paul, and Chih-hung Chang. "Dense CdS thin films on fluorine-doped tin oxide coated glass by high-rate microreactor-assisted solution deposition." *Thin Solid Films* 532 (2013): 16-21.
15. Chang, Chih-Hung, Seung-Yeol Han, Hyungdae Jin, Yu-Wei Su, Wei-Liang Yen, and Wei-Fang Su. "Develop Scalable Nanomanufacturing for Hybrid Organic-Inorganic Thin Films for Photovoltaics using Microreactor-Assisted Nanomaterial Deposition." Taipei, IUMRS-ICA (2011). **(Invited Paper)**
16. Han, Seung-Yeol, Gregory S. Herman, and Chih-hung Chang. "Low-temperature, high-performance, solution-processed indium oxide thin-film transistors." *Journal of the American Chemical Society* 133, no. 14 (2011): 5166-5169. **(Invited Paper)**
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18. Han, Seung-Yeol, Yu-Jen Chang, Doo-Hyoung Lee, Si-Ok Ryu, Gregory S. Herman, and Chih-Hung Chang, "Develop Low Temperature Solution-based Process for Oxide-based TFTs." *Proceedings of International Display Manufacturing Conference* (2009). **(Invited Paper)**

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25. Lee, D.H., Y.-J. Chang, G.S. Herman, and C.-H. Chang. "A General and Low-cost Route to Printable High-Mobility Inorganic Thin Film Transistors." *Conference Proceedings Digital Fabrication II* (2006). **(Invited Paper)**
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### Book Chapters, Books

1. Zhongwei Gao, Yu-Hsuan Yang, Ming-Huei Shen, Ho-Chun Huang, Yu-Wei Su, Changqing Pan, and Chih-hung Chang "Nanocrystalline Semiconductors for Thin Film Devices by Microreactor-Assisted Chemical Solution Deposition" *CHEMICAL SOLUTION SYNTHESIS FOR MATERIALS DESIGN AND THIN FILM DEVICE APPLICATIONS* edited by Soumen Das and Sandip Dhara, Elsevier 2020
2. Chih-hung Chang, Yujian He, Changqing Pan. "Aqueous methods for the synthesis of colloidal metal oxide nanoparticles at ambient pressure" *Colloidal Metal Oxide Nanoparticles*, Editors: Sabu Thomas and Anu Tresa Sunny, Elsevier 2019
3. Han, Seung-Yeol, Ki-Joong Kim, Chang-Ho Choi, and Chih-Hung Chang. "Synthesis and Assembly of Inorganic-Organic Hybrid Nanomaterials by Microreactor-Assisted Chemical Processes." *Nanomaterials: A Guide to Fabrication and Application* (2016): 23-52. Editor Sivashankar Krishnamoorthy, December 1, 2015 by CRC Press.
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7. "Synthesis, Assembly and Functional Application of Nanomaterials in Microsystems" A special issue of *Micromachines* (ISSN 2072-666X). Guest Editors: Chih-hung Chang and Ki-Joong Kim
8. "Nanostructured Thin Films" A special issue of *Coatings* (ISSN 2079-6412). Guest Editors: Chih-hung Chang and Seungyeol Han

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1. US Patent number 10,189,003 B1 "Continuous microwave-assisted segmented flow reactor for high-quality nanocrystal synthesis" Ki-Joong Kim, Eric Bradley Hostetler, Gregory Scott Herman, Daniel Alan Peterson, Chih-Hung Chang, Brendan Thomas Flynn, Brian Kevin Paul,

- Richard Paul Oleksak, Padmavathi Chandran, Bob C. Fitzmorris, Gustavo Henrique Albuquerque, Issue date Jan 29, 2019.
2. US Patent number 9,983,124 “Sensor devices comprising a metal-organic framework material and methods of making and using the same” Alan X. Wang, Chih-hung Chang, Ki-Joong Kim, Xinyaun Chong, Paul R. Ohodnicki, Issue date May 29, 2018.
  3. US Patent number 9,763,325 B2 “Microreactor-assisted printing of conductive traces with in-situ reactive inks” Chih-Hung Chang, Chang-Ho Choi, Issue date Sep 12, 2017 Filing date Apr 7, 2016.
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  5. US Patent No. 8,801,979 B2, “Apparatus and Method for Continuous Production of Materials” Chih-hung Chang, Hyungdae Jin. Issue date 8/12/2014.
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  7. US Patent No. 8,553,333, “Nanostructured anti-reflective coatings for substrates” Inventors: Chih-hung Chang, Seung-Yeol Han, Brian K. Paul. Issue date 10/8/2013.
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  10. US Patent No. 8,143,616, “Making a Structure” Inventors: G. Herman, P. Mardilovich, C. Betrabet, C.-H. Chang, Y.-J. Chang, D.-H. Lee. Issue date 3/27/2012.
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17. US Patent App. 15/698,569, “Sensor devices comprising a metal-organic framework material and methods of making and using the same” Chih-Hung Chang, Ki-joong Kim, Alan X Wang, Yujing Zhang, Xinyuan Chong, John P Baltrus, Paul R Ohodnicki
18. US20180011010A1, “Sensor devices comprising a metal-organic framework material and methods of making and using the same” Chih-Hung Chang, Ki-Joong Kim, Alan X Wang, Yujing Zhang, Xinyuan Chong, John P Baltrus, Paul R Ohodnicki, Pub. Date: 2018/1/11.
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20. U.S. Provisional Patent Application No. 62/189,125, “HETEROGENEOUS SURFACES FOR ENHANCED BOILING HEAT TRANSFER & ADVANCED HEAT EXCHANGER APPLICATIONS” Chih-hung Chang and Chang-ho Choi. Filed 6/6/2015, OSU Ref. No. OSU-15-18.
21. U.S. Provisional Patent Application No. 62/144,297, “Microreactor-Assisted Printing of Conductive Traces with in-situ Reactive Inks” Chih-hung Chang and Chang-ho Choi. Filed 4/7/2015, OSU Ref. No. OSU-15-18.
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23. US Patent Application 14/582,514, “A Continuous Flow Microwave-Assisted Segmented Flow Reactor for High-quality Nano Crystal Synthesis” Kim, Ki-Joong; Hostetler, Eric Bradley; Herman, Greg; Peterson, Daniel Alan; Chang, Chih-Hung; Flynn, Brendan T; Paul, Brian; Oleksak, Richard Paul; Padmavathi Chandran. Filed 12/24/2014.
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25. US Patent Application No. 13/738,896, “Flow Cell Design for Uniform Residence Time Fluid Flow” Filed 1/10/2013, OSU Ref. No. OSU-11-11, Klarquist Ref. No. 245-87507-03.

26. US Provisional Patent Application, "Flow Cell Design for Uniform Residence Time Fluid Flow in Micro-dimensional Channels" B.K. Paul, C. Hires, C. Chang, D. Palo and S. Ramprasad. Filed 2012.
27. US Patent Application, "Nanostructured Antireflection Coatings for Substrates" Chih-hung Chang, Seung-Yeol Han, Brian K. Paul. Filed 6/22/2011.
28. US Patent Application, "Apparatus and Method for Continuous Production of Nanoparticles" Chih-hung Chang, Hyungdae Jin. Filed 6/2011.
29. US Provisional patent application, "Apparatus and Method for Continuous Production of Nanoparticles" Chih-hung Chang, Hyungdae Jin. Filed 6/10/2010.
30. US patent Application, "System and method for Enhanced Heat Transfer using Nanoporous Textured Surfaces, Terry J Hendricks, Chih-hung Chang, Daniel R. Palo, Brian K. Paul.
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33. US Provisional Patent Application, "Interdigital Micromixer and Method of Manufacturing" Todd Miller, Chih-hung Chang, Brian K. Paul. Filed 9/26/2007.
34. US Provisional Patent Application, "Integrated Micromixer and Jetting Device and Method of Manufacturing" Todd Miller, Chih-hung Chang, Brian K. Paul. Filed 9/26/2007.
35. US Patent Application No. 11/897,998, "Microchemical Nanofactories" Chih-hung Chang, Brian K. Paul, Vincent T. Remcho. Filed 8/31/2007.
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37. US Patent Application No.11/086,074, "Microchemical Microfactories" Chih-hung Chang, Brian K. Paul, Vincent T. Remcho. Filed 3/21/2005.
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39. US Patent Application 20070184576, "Solution Deposition of Inorganic Materials and Electronic Devices Made Comprising the Inorganic Materials" Chih-hung Chang, Doohyoung Lee, Yu-Jen Chang. Filed 8/2007.
40. U.S. Provisional Patent Application No. 60/781, 347, "Solution Deposition of Inorganic Materials and Electronic Devices made Comprising the Inorganic Materials" Chih-hung Chang. Filed 3/10/2006.
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42. US Provisional Patent Application No. 11/490,996, "Method and Apparatus for Chemical Deposition" Chih-hung Chang. Filed 7/21/2006.



43. US Provisional Patent Application, "Method for Making Metal Oxides" G.L. Rorrer, C.-H. Chang. Filed 10/2005.
44. U.S. Provisional Patent Application No. 60/740, 707, "Digital Fabrication of Inorganic Electronic Materials" Chih-hung Chang, DooHyung Lee, Yu-Jen Chang. Filed 11/29/2005.
45. U.S. Patent Application, "Microfluidic Devices, Particularly Filtration Devices Comprising Polymeric Membranes, and Method for their Manufacturing and Use" G. Jovanovic, S. V. Atre, B.K. Paul, J. Simonsen, V.T. Remcho, C.-H. Chang. Filed 10/6/2005.
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47. U.S. Patent Application, "Structure Formation" G. Herman, P. Mardilovich, C. Betrabet, C.-H. Chang, Y.-J. Chang, D.-H. Lee. Filed 5/2004.  
US. Provisional Patent Application, "Microfluidic Devices, Particularly Filtration Devices Comprising Polymeric Membranes, and Method for their Manufacture and Use" G. Jovanovic, S. V. Atre, B.K. Paul, J. Simonsen, V.T. Remcho, C.-H. Chang. Filed 10/6/2004.

### **Invention Disclosure**

#### 1. [Invention Disclosure:](#)

2. Invention Disclosure: OSU 16-59, Nanostructured coatings for solar photovoltaics module covers. Chih-hung Chang, Yujuan He, Qun Jing.
3. Invention Disclosure: OSU 16-42, Bi-functional filter and system for water purification using solar energy. Chih-hung Chang, Michele David.
4. Invention Disclosure: OSU 16-17 with NETL, Conductive metalorganic framework chemical sensors. Chih-hung Chang, Ki-Joong Kim, Alan X. Wang, Yujing Zhang, Xinyuan Chong, Paul Ohodnicki, John Baltrus.
5. Invention Disclosure: OSU-15-32, Novel multifunctional heterogeneous surface for enhanced boiling heat transfer and its fabrication. Chih-hung Chang, Changho Choi.
6. Invention Disclosure: OSU 15-18, Microreactor-Assisted Printing of Conductive Traces with in-situ Reactive Inks. Chih-hung Chang, Chang-Ho Choi. Filed 2015.
7. Invention Disclosure: OSU 15-12, Xenon Lamp Sintering Additive Manufacturing Method. Rajiv Malhotra, William MacNeill, Chih-hung Chang..
8. Invention Disclosure: OSU-14-60 with NETL, Sensor Devices Comprising a Metal-Organic Framework Material and Method of Making and using the Same. Alan X. Wang, Chih-hung Chang, Ki-Joong Kim, Xinyuan Chong, Paul Ohodnicki.
9. Invention Disclosure: OSU 13-63, Integrated Thermal Management and Energy Recovery for Data Centers. Hailei Wang and Chih-hung Chang. Filed 2013.
10. Invention Disclosure: OSU 13-40, Method and Apparatus for the Synthesis of Nanoparticles using a Light Source. Chih-hung Chang, Peter Kreider, Ki-Joong Kim. Filed 2013.
11. Invention Disclosure: OSU 13-27, Segmented Flow for a Continuous Flow Microwave Reactor. G.S. Herman, K.J. Kim, C.-H. Chang, B.K. Paul, R. Oleksak, Chandran Padmavathi, E. Hosteler, F. Brendan, D. Peterson.

12. Invention Disclosure: OSU 12-19, Zinc tin oxide semiconductors for memristor applications. Gregory Herman, John F. Conley, Chih-hung Chang.
13. Invention Disclosure: OSU 11-65, Novel antireflection coatings structure and method of fabrication. Chih-hung Chang, Brian K. Paul, Seung Yeol Han.
14. Invention Disclosure: OSU 11-61, Low temperature annealing process for the fabrication high performance amorphous oxide TFTs. C.-H. Chang, S.-Y. Han, G.-S. Herman. Filed 2012.
15. Invention Disclosure: OSU 11-11, Flow Cell Design for Uniform Residence Time Fluid Flow in Micro-Dimension Channels. B.K. Paul, C. Hires, C. Chang, D. Palo and S. Ramprasad. Filed 1/2011.
16. Invention Disclosure: OSU 10-68, Novel Nanostructured Antireflection Coating (ARC). Chih-hung Chang, Brian K. Paul, Seung Yeol Han
17. Invention Disclosure: OSU 10-65, Novel  $\text{CuInGaSe}_2$  solar cell structure and fabrication processes. . Chih-hung Chang and Wei Wang.
18. Invention Disclosure: OSU 09-34 with PNNL, Nano-Structured Surfaces to Enhance Surface Hydrophilicity or Boiling Heat Transfer. Chih-hung Chang, Brian K. Paul, Daniel Palo, Terry Hendricks.
19. Invention Disclosure: OSU 08-61, Method, Apparatus, and Compositions for Making Antireflection Coating for Substrates. Chih-hung Chang, Brian K. Paul, and Seung-Yeol Han.
20. Invention Disclosure: OSU 08-51, Method and Apparatus for Continuous Production of I-III-VI (Cu,Ag)(In,Ga,Al)(Se, S, Te) Semiconducting Nanoparticles. Chih-hung Chang, Hyudae Jin, Yu-Wei Su.
21. Invention Disclosure: OSU 08-50, Solution Processes for Making I-III-VI-based Thin Film Solar Cells. Chih-hung Chang, Wei Wang.
22. Invention Disclosure: OSU 08-36, Graded Bandgap Nanostructured Solar Cell using size dependent quantum dots and nanowire arrays. Chih-Hung Chang.
23. Invention Disclosure: OSU-08-19, Microreactor- Assisted Deposition of Metallic Nanoparticles for the Diffusion Bonding and Brazing of Metals and Alloys. Inventors: Brian K. Paul, Chih-Hung Chang, Santosh Tiwari. Provisional filed 5/15/08.
24. Invention Disclosure: OSU 07-66 with PNNL, Economical Packaging Methods for Heterogeneous Catalytic Microreactors. Santosh Tiwari, Dan Palo, Chih-Hung Chang, Brian K. Paul.
25. Invention Disclosure: OSU 07-64, Novel Spin Coat Deposition Method. C-H Chang.
26. Invention Disclosure: New Methods and Apparatus for Successive Ionic Layer Adsorption and Reaction Deposition Process. Chih-Hung Chang.
27. Invention Disclosure: OSU 07-27, Integrated micromixer and jetting device and method of manufacture. Richard Todd Miller, Chih-hung Chang, Brian K Paul.
28. Invention Disclosure: OSU 07-08, Interdigital Micromixer and Method of Manufacture. Todd Miller, Chih-hung Chang, Brian K. Paul.
29. Invention Disclosure: OSU 05-39, A Simple And General Route To Digital Fabrication Of Inorganic Electronic Materials. Chih-Hung Chang, Doo Hyong Lee, Yu-Jen Chang.

30. Invention Disclosure: OSU 05-31, Biological Fabrication of Nanostructured Metal Oxides Possessing Blue Photoluminescence. Greg Rorrer, C.-H. Chang.
31. Invention Disclosure: OSU 05-25, Novel Continuous Flow Microchemical Systems for the Deposition of Functional Thin Films. C-H Chang, P. Mugdur.
32. Invention Disclosure: OSU 04-34, Chemical Bath Deposition. C.-H. Chang, P. Mugdur.
33. Invention Disclosure: OSU 04-21, Microfluidic devices, particularly filtration devices comprising polymeric membranes, and method for their manufacture and use. S. Atre, J. Simonsen, S. Noorani, R. Urval, G. Jovanovic, B.K. Paul, C-H Chang, V. Remcho.
34. Invention Disclosure: OSU 03-36, Oregon State University, Microchemical ‘Fractories’ for High-Yield Synthesis of Converging Dendritic Nanoarchitectures. C.-H. Chang, B.K. Paul, V. Remcho.
35. Invention Disclosure: 200503540, Hewlett-Packard Co. Novel Chemistry Route for Porous Metal Oxides. C.-H. Chang, Y.-J. Chang, D.-H. Lee, D. Punsalan, G.S. Herman.
36. Invention Disclosure: 200407134, Hewlett-Packard Co. Direct dissolution and recrystallization of metal halide semiconductors. Gregory Herman, C.-H. Chang, D.-H. Lee, Y.-J. Chang, C.-H. Park, D. Keszler.
37. Invention Disclosure: 200316010, Hewlett-Packard Co. Materials Growth Combining Inkjet Printing and Microwave Processing. G. Herman, P. Mardilovich, C. Betrabet, C.-H. Chang, Y.-J. Chang, D.-H. Lee.
38. Invention Disclosure: 200316264, Hewlett-Packard Co. Conversion, Self-Patterning, and Formation of Continuous Film via Microwave Processing. G. Herman, P. Mardilovich, M.W. Hoskins, C.-H. Chang, Y.-J. Chang, D.-H. Lee.

## **PRESENTATIONS**

### **Invited and Peer-Selected Presentations**

#### **a. Invited Presentations**

1. Scalable Nanomanufacturing of Bio-Inspired Thin Films, Chih-hung Chang, NanoES Seminar June 3, 2021, UW/OSU
2. Transformation, Reaction and Organization at Functional Interfaces for Sustainable Energy Systems Using Microreactor-Assisted Nanomaterial Deposition Process, Chih-hung (Alex) Chang, April 18, EN10, Transformation, Reaction and Organization at Functional Interfaces for Sustainable Energy Systems and Environmental Managements, 2021 MRS Spring Meeting in Seattle, Washington from April 18-23, 2021.
3. Transform the research from academia into industry. Chih-hung (Alex) Chang. Date/time: April 27 2020 OSU postdoctoral association (OPA)
4. Chih-hung Chang, Brian Paul, Fabrication of Nanomaterials using Microreactor-assisted printing for Joining, Joining of Advanced and Specialty Materials XXI – Micro and Nano-Joining/Steel Welding, MS&T19 Portland, Oregon October 2, 2019.

5. Chih-hung Chang, Preparation of Hybrid Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterials Synthesis and Deposition Process, Hybrid Organic-Inorganic Materials for Alternative Energy II, MS&T19 Portland, Oregon October 3, 2019.
6. Chih-hung Chang, Rajiv Malhotra, Kostas Sierros, Develop Solution-based, Direct-printing Processes of Inorganic Semiconductors for Electronics and Energy Applications, TMS 2019 Annual Meeting & Exhibition, | Henry B. González Convention Center, San Antonio, Texas, March 10-14, 2019.
7. Chih-hung Chang, Preparation of Inorganic Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterial Synthesis and Deposition Process, Department Seminar, Mechanical and Materials Engineering, Portland State University, Portland Oregon Friday November 16, 2018.
8. Chih-hung Chang, Rajiv Malhotra, Printable Functional Materials for Smart Fabrics, TMS 2018 Annual Meeting & Exhibition, | Phoenix Convention Center, Phoenix, Arizona, March 11-15, 2018.
9. Chih-hung Chang, Y. He, A. Chang, M. TorresArango, R. Malhotra, K. Sierros, Fabrication of Micro- and Nanostructured Materials using Microreactor-Assisted Chemical Processes, 2018 Glass & Optical Materials Division Annual Meeting, Hilton Palacio del Rio, San Antonio, Texas May 24, 2018.
10. Chih-hung Chang, Preparation of Inorganic Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterial Synthesis and Deposition Process, Department of Mechanical Engineering, Baylor University, February 12, 2018.
11. Chih-hung Chang, “Preparation of Inorganic Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterial Synthesis and Deposition Process” Seminar, Department of Materials Science and Engineering, West Virginia University, Morgantown WV, USA, January 27, 2017.
12. Michele David, Chang-Ho Choi, Zhongwei Gao, Alvin Chang, Marshall Allen, Hailei Wang, Chih-hung Chang, “Scalable Design and Fabrication Multifunctional Phase Change Heat Transfer Surface”, The 8<sup>th</sup> International Electronic Cooling Workshop, Stockholm, Sweden, Nov 16 17, 2016.
13. Chih-hung Chang, “Printed Metal Oxide Transistors”, SID Display Week 2016, San Francisco, CA, USA, May 2016.
14. Chih-hung Chang, “Inkjet Printed Metal Oxide Thin Film Transistors”, Symposium: Recent Advancement on Stretchable and Wearable Electronics, 2016 TMS Annual Meeting & Exhibition, Nashville, TN, USA, February 15, 2016.
15. Chih-hung Chang, “Preparation of Inorganic Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterial Synthesis and Deposition Process”, Seminar, Department of Materials Science and Engineering, Washington State University, USA, September 25, 2015.
16. Chang-Ho Choi, Jenna Gorecki, Zhen Fang, Marshall Allen, Chih-hung Chang, Liang-Yu Lin, Chun-Cheng Cheng, “Inkjet Printed P-type Semiconductors and Thin Film Transistors”, IDMC’15, Industrial Display Manufacturing Conference & 3D System and Applications, TWTC Nangang, Taiwan, August 25-28, 2015.

17. Chih-hung Chang, “Preparation of Inorganic Nanomaterials and Nanostructured Thin Films using Microreactor-Assisted Nanomaterial Synthesis and Deposition Process”, Invited Lecture, Third International Conference on Advanced Complex Inorganic Nanomaterials Namur, Belgium, July 16, 2015.
18. Chih-hung Chang, “Preparation of Micro/Nano Hierarchical Materials using Scalable Microreactor-Assisted Nanomaterials Synthesis and Deposition Process”, Plenary Lecture, International Workshop on Hierarchical Materials: Green Chemistry on Micro/Nano Hierarchical Materials Namur, Belgium, July 15, 2015.
19. Chih-hung Chang, “Microreactor-Assisted Chemical Processes for Nanomaterials Synthesis, Assembly and Deposition”, March 31 2015, Idaho National Laboratory, Idaho Falls, ID, USA.
20. Chih-hung Chang, “Scalable Nanomanufacturing for Photovoltaics using Microreactor-Assisted Nanomaterial Synthesis and Deposition Processes”, EMN Meeting on Photovoltaics, Jan 13, Orlando, FL, USA, 2015.
21. Chih-hung Chang, “Microreactor-Assisted Nanomaterial Processing: Scaling by an Equal Up and Equal Down Approach”, The 2nd SKY International Joint Symposium on Green Chemistry and Clean Technology, Daegu, Korea, Nov 13-15, 2014.
22. Chih-hung Chang, “Develop Novel Solution-Based Precursors and Processes for High-Performance Earth Abundant Thin Film Solar Cells”, 2nd OSU DGIST Bilateral PV Symposium, Daegu, Korea, Nov 6, 2014.
23. Chih-hung Chang, “Microreactor-Assisted Nanomaterial Processing: Scaling by an Equal Up and Equal Down Approach”, ASME Scalable Nanomanufacturing Workshop, Buffalo NY, USA, August 17, 2014.
24. Chih-hung Chang, “Microreactor-Assisted Nanomaterial Processing: Scaling by an Equal Up and Equal Down Approach”, CMOS Emerging Technologies Research, MINATEC Grenoble, France, July 7, 2014.
25. Chih-hung Chang, “Microchannel Assisted Nanomaterial Deposition Technology for Photovoltaic Material Production, Photovoltaic”, WCCE9 & APCChE 2013, COEX, Seoul, Korea, Aug 20, 2013.
26. Chih-hung Chang, “Fabrication of Compound Semiconductors using Microreactor-Assisted Solution Processes”, DGIST, Daegu, Korea, Aug 19, 2013.
27. Chih-hung Chang, “Solution Routes towards Amorphous Oxide Semiconductors”, SID Taipei, National Chia-Tung University, Hsinchu Taiwan, Aug 2013.
28. Chih-hung Chang, “Fabrication of Compound Semiconductors Using Microreactor-Assisted Solution Deposition”, FF3.04, Session FF3: Nano-devices Symposium FF Compound Semiconductors for Generating, Emitting, and Manipulating Energy –II April 2-5, 2013 MRS Spring Meeting, San Francisco, California, USA, April 3, 2013.
29. Chih-hung Chang, “Microreactor-Assisted Nanomaterials Deposition”, TCO Seminar, DOW Electronics, Marlborough, MA, USA, October 26, 2012.
30. Chih-hung Chang, “Biomimetic Nanostructured Coatings”, Oregon BEST FEST, USA, September 12, 2012.

31. Chih-hung Chang, “Develop Scalable Nanomanufacturing using Microreactor-Assisted Nanomaterial Deposition Processes”, Solid State Seminar, Physics, Oregon State University, USA, May 2012.
32. Chih-hung Chang, “Develop Solution-based Process for thin films”, Science Colloquium, Linfield College, Oregon, USA, May 3, 2012.
33. Chih-hung Chang, “Microreactor-Assisted Nanomaterial Production and Deposition”, 2011-2012 Winter/Spring Seminar Series, Department of Chemical & Biological Engineering, Drexel University, USA, March 16, 2012.
34. Chih-hung Chang, Seung-Yeol Han, Hyungdae Jin, Yu-Wei Su, Wei-Liang Yen, Wei-Fang Su, “Develop Scalable Nanomanufacturing for Hybrid Organic-Inorganic Thin Films for Photovoltaics using Microreactor-Assisted Nanomaterial Deposition”, IUMRS-ICA 2011, Taipei, Taiwan, September 22, 2011.
35. Chih-hung Chang, “Development of Scalable Nanomanufacturing for Photovoltaics using Microreactor-Assisted Nanomaterial Deposition”, Sustainable Nanomanufacturing, ASME 2011 International Manufacturing Science and Engineering Conference, Oregon State University, Corvallis, Oregon, USA, June 13-17, 2011.
36. Chih-hung Chang, “INNOVATION WATCH: Microreactor-Assisted Nanomaterials Deposition: A Scalable Route for Nanomanufacturing Innovations that Could Change the Ways you Manufacture”, 2011 SME Annual Conference Seattle, WA, USA, June 7, 2011.
37. Chih-hung Chang, “Microreactor-Assisted Nanomaterial Deposition for Scalable Nanomanufacturing”, CMOS Emerging Technologies, Whisler, British Columbia, Canada, June 15-17, 2011.
38. Chih-hung Chang, Seung-Yeol Han, Gregory S. Herman, “Low-Temperature, High Performance, Solution-Processed Indium Oxide Thin Film Transistors”, International Display Manufacturing Conference 2011, Taipei, Taiwan, April 19, 2011.
39. C.-H. Chang, “Develop Scalable Nanomanufacturing for Photovoltaics using Microreactor-Assisted Nanomaterial Deposition Processes”, 8<sup>th</sup> US Air Force Taiwan Nanoscience Workshop, Seattle, WA, USA, April, 2011.
40. C.-H. Chang, “Microreactor-Assisted Nanomaterial Production and Deposition”, DOE NETL Albany, Oregon, USA, January 21 2011.
41. C.-H. Chang, “Develop Scalable Nanomanufacturing for Photovoltaics using Microreactor-Assisted Nanomaterial Deposition Processes Advancements in Nanotechnology Workshop”, EPRI Charlotte, USA, January 12-13, 2011.
42. C.-H. Chang, “Deposition of Nanoscale Thin Films by Microreactor-Assisted Chemical Solution Deposition, High Performance Solution-Processed Materials for Electronic/Optoelectronic Device Applications”, PacificChem 2010, Honolulu, Hawaii, USA, December 2010.
43. C.-H. Chang, “Synthesis and post-processing of nanomaterials using microreaction technology”, The 10th Emerging Information & Technology Conference, James H. Clark Center, Stanford University, Stanford, California, USA, August 14-15, 2010.

44. Changho Choi, Shankar Krishnan, SeungYeol Han, Terry J. Hendricks and Chih-hung Chang, "Enhanced boiling heat transfer using solution-processed ZnO nanostructured surface on aluminum", 7<sup>th</sup> US Air Force Taiwan Nanoscience Workshop, Taiwan.
45. C.-H. Chang, "Develop Solution-based Processes of Inorganic Semiconductors for Electronics and Energy Applications", Department of Paper and Chemical Engineering Miami University, Ohio, USA, October 23, 2009.
46. C.-H. Chang, "Chemical Solution Deposition: A Low Cost Process for Photovoltaics", Solar Materials Symposium, Micro Nano Breakthrough Conference, September 21, 2009.
47. C.-H. Chang, "Microreactor-Assisted Nano Deposition Process", The 9<sup>th</sup> Emerging Information & Technology Conference Massachusetts Institute of Technology, Boston, USA, August 6, 2009.
48. C.-H. Chang, "Oxide Thin-Film Transistors Fabricated by Inkjet Printed Channel Layers", The Sixteenth International Workshop on Active-Matrix Flat Panel Displays and Devices – TFT Technologies and FPD Materials, Nara Centennial Hall, Nara Japan, July 1-3, 2009.
49. Brian K. Paul, C.-H. Chang, "Microreactor-Assisted Nanomaterial Synthesis and Deposition (MAND)", EMSL conference room, PNNL, USA, March 11 2009.
50. C.-H. Chang, "Develop Solution-based Processes for Flexible and Printing Electronics", Sharp Laboratories of America, Camas, WA, USA, June 2009
51. C.-H. Chang, "Develop Solution-based Processes for Flexible and Printing Electronics", Solid-State Seminar, Department of Physics, Oregon State University, USA, May 6, 2009.
52. C.-H. Chang, "Develop Low Temperature Solution-based Process for Oxide-based TFTs", International Display Manufacturing Conference 2009, Taipei, Taiwan.
53. C.-H. Chang, "Microreactor Assisted Nano Deposition Process", 6<sup>th</sup> Taiwan/U.S. Air Force Nanoscience Workshop, San Francisco CA, USA, April 2009.
54. C.-H. Chang, "Develop Printable Solution Processes for Inorganic Semiconductors" Symposium F Low-Cost Solution-Based Deposition of Inorganic Films for Electronic/Photonic Devices, MRS meeting, Boston, USA, Fall 2008.
55. C.-H. Chang, "Develop Printable Solution Processes for Inorganic Semiconductors", Proceedings of 2008 Crystal Valley Conference, Sun Moon University, Asan-City, Korea, Nov 12 2008.
56. C.-H. Chang, "Develop Solution-based Processes for Flexible and Printing Electronics", Department of Electrical Engineering, Kun Shan University, Tainan Hsien, Taiwan, September 2008.
57. C.-H. Chang, "Develop Solution-based Processes for Flexible Electronics", Department of Materials Science and Engineering, National Taiwan University, Taiwan, September 15 2008.
58. C.-H. Chang, "Develop Solution-based Processes for Flexible Electronics", Department of Chemical Engineering, National Taiwan University of Science and Technology, Taiwan, August 2008.
59. C.-H. Chang, "Develop Solution-Based Processes for Flexible and Printed Electronics", 2008 Flexible Electronics Seed Teacher Training Class, Aug 4-8, 2008.

60. C.-H. Chang, "Investigation of Chemical Bath Deposition by a Continuous Flow Microreactor," The 8<sup>th</sup> Emerging Information and Technology Conference, Jun 26-27, 2008.
61. C.-H. Chang, D.-H. Lee, Y.-J. Chang, S.-Y. Han, G. S. Herman, "Develop Printable Solution Processes for Oxide Semiconductors", 2008 Taiwan Display Conference, Taipei, Taiwan, 2008.
62. C.-H. Chang, "Develop Solution-based Processes for Flexible and Printed Electronics", NWRC 2007, Portland, Oregon, USA, 2007.
63. C.-H. Chang, G.S. Herman, "Inkjet Printed Materials and Devices", Symposium N Printing Methods for Electronics, Photonics, and Biomaterials, MRS 2007 Spring Meeting, San Francisco, USA, April 2007.
64. C.-H. Chang, "Synthesis and Deposition of Nanomaterials Using a Continuous Flow Microreactor", 2007 Taiwan-US Soft Materials Symposium, Taiwan, Jan 2007.
65. C.-H. Chang, D.-H. Lee, Y.-J. Chang, G.S. Herman, "A General and Low-Cost Route to Printable High-Mobility Inorganic Thin Film Transistors", Digital Fabrication, USA, September 2006.
66. C.-H. Chang, "Fabrication of Luminescent Materials using Biogenic Nanostructured Semiconductor Metal Oxides from Marine Diatoms", NSF/ANR/NASA, France- U.S. Workshop on Nanobiotechnology, Washington, DC, USA, March 2, 2006.
67. C.-H. Chang, "Develop Solution-based Process for Flexible and Printing Electronics", Yeungnam University, Korea, March 29, 2006.
68. C.-H. Chang, "Develop Solution-based Process for Flexible and Printing Electronic", Advanced Lecture series, Hewlett Packard, USA, March 14, 2006.
69. C.-H. Chang, "Thin Film Electronic Materials via Soft Solution Processes", The 5<sup>th</sup> International Symposium on Clean Technology, Yeungnam University, Kyongsan, Korea, April 25, 2005.
70. C.-H. Chang, "Process Engineering of Low Temperature Chemical Bath Deposition Technique for Flexible Electronics", International Symposium on Display Materials and Devices, Yosu, Korea, April 22, 2005.
71. C.-H. Chang, "Production of Semiconductor Nanocrystals via Microreaction Technology", Department of Mechanical Engineering, Graduate Institute of Polymer Science and Engineering, National Taiwan University, Taipei, Taiwan, April 6, 2004.
72. C.-H. Chang, "Chemical Bath Deposition: A Soft Solution Route to Flexible Electronics" & "Lab-based Unit Operations in Microelectronics processing", School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea, March 26, 2004.
73. C.-H. Chang, "Characterization and Application of Semiconductor Thin Films Deposited by Chemical Bath Deposition", Electronics and Telecommunications Research Institute, Daejeon, Korea, March 24, 2004.
74. C.-H. Chang, "Chemical Bath Deposition: A Soft Solution Route to Flexible Electronics" & "Lab-based Unit Operations in Microelectronics processing", Department of Chemical Engineering Kyungpook National University, Daegu, Korea, March 23, 2004.



75. C.-H. Chang, “Chemical Bath Deposition: A Soft Solution Route to Flexible Electronics” & “Lab-based Unit Operations in Microelectronics processing”, Department of Chemical Engineering, University of Washington, Seattle, Washington, USA, March 1, 2004.
76. C.-H. Chang, “Long and Short Range Ordering of Copper Indium Selenide Semiconductors”, Departmental Seminar, Department of Materials Science and Engineering, University of Washington, Seattle, WA, USA, December 2000.

#### **As a co-author to Invited Presentations**

1. S.-H. Liu, C.-H. Chang, T. Tseng, R.T. Miller, B.K. Paul, M. Koesdjojo, Y. Tennico, J.T. Rundel, V.T. Remcho, “Progress Towards Integrated Microchemical Nanofactories: Devices for Efficient Production of Nanomaterials”, Micro Nano Breakthrough Conference 2007 Portland, Oregon
2. Timothy Anderson, Woo Kyoung Kim, Suku Kim, Seokhyun Yoon, Chih-hung Chang, Jianyun Shen, E. Andrew Payzant, “Routes to Formation of  $\text{CuIn}_x\text{Ga}_{1-x}\text{Se}_2$  Thin Film Absorbers for Photovoltaics”, Symposium: Materials in Clean Power Systems 2: Fuel Cells, Solar, and Hydrogen-Based Technologies, 2007 TMS Annual Meeting & Exhibition.
3. T. J. Anderson, W. K. Kim, S. Kim, S. Yoon, C.H. Chang, J. Shen, and E. A. Payzant, “Reaction Pathways and Kinetics of  $\text{CuIn}_x\text{Ga}_{1-x}\text{Se}_2$  Thin Film Growth” Symposium on Thin Film Chalcogenide Photovoltaic Materials E-MRS 2006 meeting Strasbourg, France, May 29, 2006.
4. G.L. Rorrer, C.-H. Chang, C. Jeffryes, S.-H. Liu, T. Qin, J. Jiao, “Cellular Biosynthesis of Nanostructured Semiconductor Materials” 229<sup>th</sup> National Meeting of the American Chemical Society (ACS), Division of Industrial & Engineering Chemistry (I&EC), Session on Nanotechnology and the Environment, San Diego CA, March 2005.
5. C-H Chang, S. Serkan, S. Kim, B. Stanbery, Lei L Kerr, S.S. Li, O.D. Crisalle, T.J. Anderson, O.D. Crisalle, R.N. Noufi, “Progress Towards Next Generation CIGS Solar Cells” The 16th European Photovoltaic Solar Energy Conference, 2001.
6. Tim Anderson, C.-H. Chang, Weidong Zhuang, Mushin Ider, Billy Stanbery, Jianyun Shen, “Using Computational Thermodynamics to design  $\text{CuInSe}_2$  Thin Film Solar Cells” 2001 TMS-The Minerals, Metals & Materials Society Annual Meeting Annual Meeting, New Orleans, Louisiana.
7. Tim Anderson, C.-H. Chang, Billy Stanbery, L. Li, Weidong Zhuang, Mushin Ider, “Phase Equilibria in the Cu-In-Ga-Se System and Its Implications for Synthesis of CIS absorber Films” Materials Research Society Spring Meeting, San Francisco, CA, April 2001.

#### **Peer-Selected Conference Oral Presentations**

1. Milad Ghayoor, Kijoon Lee, Yujuan He, Chih-hung Chang, Brian Paul, Someya Pasebani, High-temperature Mechanical Properties and Microstructure of Additively Manufactured 304L Stainless Steel ODS Alloy: Additive Manufacturing of Metals: Microstructure,

- Properties and Alloy Development – Additive Manufacturing of Composite Materials and Composite Like Structures, MS&T19 Portland, Oregon October 3, 2019.
2. Amir Dehghanhadikolaei, Kijoon Lee, Vinay Doddapaneni, Lukas Freiberg, Mathew Coblyn, Chih-hung Chang, Goran Jovanovic, Brian Paul, Someya Pasebani, Selective Laser Melting of Inconel 625 Superalloy with Enhanced Hardness: Additive Manufacturing of Metals: Microstructure and Materials Properties of Nickel-based Alloys –AM Process – Microstructure – Properties, MS&T19 Portland, Oregon October 2, 2019.
  3. Chih-hung Chang, Scalable nanomanufacturing of bio-inspired optical thin films using microreactor-assisted nanomaterial synthesis and deposition process, Bio-inspired Optics and Photonics – From Metamaterials to Applications, International Focus Workshop, Max-Planck-Institute für Physik komplexer Systeme, Dresden Germany 24-27 June 2019.
  4. Yujuan He, Alvin Chang, Chih-hung Chang, Fabrication of Optically Transparent Glass via a Microfluidic-assisted Sol-Gel 3D-print, TMS 2019 Annual Meeting & Exhibition, | Henry B. González Convention Center, San Antonio, Texas, March 10-14, 2019
  5. M. Ghayoor, K. Lee, Y. He, C.-H. Chang, B.K. Paul, S. Pasebani, Additive Manufacturing of 304 Stainless Steel Oxide Dispersion Alloy via Selective Laser Melting, TMS 2019 Annual Meeting & Exhibition, | Henry B. González Convention Center, San Antonio, Texas, March 10-14, 2019
  6. M. Ghayoor, K. Lee, Y. He, C.-H. Chang, B.K. Paul, S. Pasebani, Additive Manufacturing of 304 Stainless Steel Oxide Dispersion Alloy via Selective Laser Melting, TMS 2019 Annual Meeting & Exhibition, | Henry B. González Convention Center, San Antonio, Texas, March 10-14, 2019
  7. A. Chang, Y. He, M. TorresArango, R. Malhotra, K. Sierros, C. Chang, Novel Approaches towards Create Colored Nanoporous Sol-Gel Glasses, 2018 Glass & Optical Materials Division Annual Meeting, Hilton Palacio del Rio, San Antonio, Texas, May 24, 2018.
  8. A. Chang, Y. He, M. TorresArango, R. Malhotra, K. Sierros, C. Chang, Novel Approaches towards Create Colored Nanoporous Sol-Gel Glasses, 2018 Glass & Optical Materials Division Annual Meeting, Hilton Palacio del Rio, San Antonio, Texas May 24, 2018.
  9. Yujuan He, Ki-Joong Kim, Chih-hung Chang, Continuous, size and shape-control synthesis of hollow silica nanoparticles enabled by a microreactor-assisted rapid mixing process, 19th International Sol-Gel Conference, Liege - Belgium, September 3-8, 2017.
  10. Chih-hung Chang, “Develop Scalable Nanomanufacturing Processes for Energy Applications”, 2015 DGIST OSU Bilateral Symposium on Green Energy Generation and Storage, MBI, Corvallis, OR, USA, December 17, 2015.
  11. Chih-hung Chang, “Microreactor-Assisted Nanomaterials Printing for Anti-smudge and Anti-glare Coatings on Eyeglasses and Smartphone Display”, TechConnect World Innovation Conference & Expo, Washington DC, USA, June 14-17, 2015.
  12. Changho Choi, Zhen Fang, Jenna Gorecki, Marshall Allen, Chih-hung Chang, Liang-Yu Lin, Chun-Cheng Cheng, “Printed p-type CuI TFTs”, 2015 NIP & Digital Fabrication Conference, Portland Oregon.

13. Yujuan He, Harrison R. Holzgang, Ki-Joong Kim, Chih-Hung Chang, "Inkjet Printed Hollow Silica Nanoparticles for Anti-Reflective Coatings", 2015 NIP & Digital Fabrication Conference, Portland Oregon.
14. Changho Choi, Michele David, Zhongwei Gao, Alvin Chang, Marshall Allen, Chih-hung Chang, "Controlled Bubble Dynamics on Printed Heterogeneous surface", ASME InterPACK/ICNMM 2015, The Fairmont San Francisco, CA, USA, July 6-9, 2015.
15. Changho Choi, Elizabeth Allan-Cole, Chih-Hung Chang, "Room Temperature Highly Conductive Silver Film via a Continuous Flow Microreactor Deposition", 2015 Materials Research Society Spring Meeting, San Francisco CA, April 2015.
16. Yujuan He, Katherine Han, Chih-hung Chang, "Synthesis, Optical Modeling and Characterization of Antireflective Coating based on Hollow Silica nanoparticles", 25<sup>th</sup> Annual Symposium of the Pacific Northwest Chapter of the AVS, at EMSL Richland, WA, September 16-19, 2014.
17. Chih-hung Chang, Ki-Joong Kim, Peter Kreider, "Continuous Synthesis of Shape-Controlled Colloidal Chalcopyrite Copper Indium Diselenide Nanocrystal Inks", 372e, Nanocrystal Science and Technologies, AIChE Annual Meeting, San Francisco CA, USA, Nov 5, 2013.
18. Chih-hung Chang, Changho Choi, "Controlled Aqueous Synthesis of ZnO Nanofilms Using Physical Means", 634b, Nanostructured Thin Films, Nanostructured Thin Films, AIChE Annual Meeting, San Francisco, USA, Nov 7, 2013.
19. Ki-Joong Kim, Chih-hung Chang, "A facile synthesis of CuInSe<sub>2</sub> nanocrystals using a continuous flow microwave-assisted reactor", Microwave & Flow Conference 2013, Silverado Resort & Spa, Napa Valley, California, USA, July 20-23, 2013.
20. Seung-Yeol Han, Wei Wang, Scott Weaver, Brian K Paul, Chih-hung Chang, "Solution-processed Nanoparticles Deposition of Nanostructured Surface Antireflective Coatings (ARCs) for PV Applications", 2012 Materials Research Society Spring Meeting, San Francisco, CA, USA, April 2012.
21. Seung-Yeol Han, Chih-hung Chang, Gregory S. Herman, "Printed Transparent Amorphous Oxide Semiconductors, High Performance Solution-Processed Materials for Electronic/Optoelectronic Device Applications", PacificChem 2010, Honolulu, Hawaii, USA, December 2010.
22. Seung-Yeol Han, Gregory S. Herman, Chih-hung Chang, "Low Temperature, High-Performance, Solution-Processed Indium Oxide Thin Film Transistors", 218th ECS Meeting Las Vegas, Nevada, USA, October 10-15, 2010.
23. Terry J. Hendricks, Shankar Krishnan, Chih-hung Chang and Brian K. Paul, "Enhancement of Pool Boiling Heat Transfer using Nanostructured Surfaces on Aluminum, Copper and Silicon", Sixth Annual Micro Nano Breakthrough Conference, Portland Oregon, USA, September 22 2009.
24. Yu-Jen Chang, Yu-Wei Su, Seung-Yeol Han, Gregory S. Herman, Chih-hung Chang, "Investigate the reacting flux of chemical bath depositon by a continuous flow microreactor", Symposium F Low-Cost Solution-Based Deposition of Inorganic Films for Electronic/Photonic Devices, MRS, Boston, USA, Fall 2008.

25. Timothy J. Anderson, Chih-hung Chang, Andrew Pazant, "Evaluation of Pathways to the Synthesis of Cu(In,Ga)Se<sub>2</sub> Solar Cell Absorbers", Thermodynamics and Transport Properties (01a) #356 - John O'Connell 70th Birthday Celebration II (01A02) AIChE annual meeting Philadelphia, PA, USA, November 18, 2008.
26. Debra K. Gale, Timothy Gutu, Jun Jiao, Chih-hung Chang and Gregory L. Rorrer, "Antibody Functionalization of Nanostructured Diatom Biosilica for Selective Detection of Biomolecules by Enhanced Photoluminescence", Bionanotechnology (22b) #494 - Nanotechnology and Nanobiotechnology for Sensors II AIChE Annual Meeting, USA, November 19, 2008.
27. Lallie C. McKenzie, Hyungdae Jin, Daniela Hutanu, Chih-hung Chang, Vincent T. Remcho, James E. Hutchinson, "Advances in nanoparticle synthesis: Enhanced process control, real-time analysis, and high-throughput production using microscale flow reactors", 235<sup>th</sup> ACS National Meeting, New Orleans, LA, USA, April 6-10, 2008
28. S.-H. Liu, C.-H. Chang, T. Tseng, R.T. Miller, B.K. Paul, M. Koesdjojo, Y. Tennico, J.T. Rundel, V.T. Remcho, "Progress Towards Integrated Microchemical Nanofactories: Devices for Efficient Production of Nanomaterials", 2008 Micro Nano Breakthrough Conference Vancouver, WA, USA, September 8-10, 2008.
29. C. Jeffryes, Haiyan Li, T. Gutu, J. Jiao, C.-H. Chang, M.E. Jones, G.L. Rorrer, "Biological Fabrication of Nanostructured TiO<sub>2</sub> Thin Films for Solar Cell Applications", 2008 Micro Nano Breakthrough Conference Vancouver, WA, USA, September 8-10, 2008.
30. C. Jeffryes, T. Gutu, J. Jiao, C.-H. Chang, G.L. Rorrer, "Two-Stage Bioreactor Culture of the Pennate Diatom *Pinnularia* sp. for the Fabrication of a TiO<sub>2</sub>-based Solar Cell", 2008 Meeting of the Northwest Algal Symposium, Charleston, OR, USA, April 5, 2008.
31. Clayton Jeffryes, Gregory Rorrer, Chih-hung Chang, Jun Jiao and Timothy Gutu, "Diatom Cell Culture for the Self-Assembly of Silicon-Titanium Oxides Ordered at the Submicron and Nanoscales", 2007 AIChE Annual Meeting.
32. T. Gutu, J Wu, C Jeffreys, C-H Chang, G Rorrer and J Jiao, "Dual Beam Focused Ion Beam and Transmission Electron Microscopies of Nanoscale Sectioned Diatom Frustules", Microscopy and Microanalysis 2007 in Ft. Lauderdale, Florida, USA, August 5-9, 2007.
33. G.L.Rorrer, C.-H. Chang, C. Jeffryes, T. Qin, J. Jiao, T. Gutu, "Biological Fabrication of Metal Oxide Nanostructures Possessing Novel Optoelectronic Properties", Session (638) Supramolecular Assembly of Inorganic Materials I, 2006 AIChE Annual Meeting, San Francisco, CA, Nov 17, 2006.
34. C. Jeffryes, T. Gutu, C.-H. Chang, T. Qin, J. Jiao, G.L. Rorrer, "Two-Stage Diatom Cell Culture for the Supramolecular Assembly of Silicon-Germanium Oxides Ordered at the Submicron and Nanoscales", Session (521) Supramolecular Assembly of Inorganic Materials I, 2006 AIChE Annual Meeting, San Francisco, CA, USA, Nov 16, 2006.
35. C.-H. Chang, Y.-J. Chang, D.-H. Lee, S.O. Ryu, T. J. Lee, "Investigation of CdS Thin Film Deposition Kinetics using a Continuous Flow Microreactor", Session (45) Reaction Kinetics in Electronic Materials Processing, 2006 AIChE Annual Meeting, San Francisco, CA, USA, Nov 13, 2006.

36. Y.-J. Chang, P. H. Mugdur, and C.-H. Chang, "A Continuous Flow Microreactor for Chemical Bath Deposition", 2006 Symposium of the Pacific Northwest Chapter of the AVS, Forest Grove, OR, USA, September 21 2006.
37. D.-H. Lee, C. Jeffryes, T. Qin, G.L. Rorrer, C.-H. Chang, "Fabrication of Luminescent Materials using Biogenic Nanostructured Oxides from Marine Diatoms", T4.9, Symposium T: Nanomanufacturing, Materials Research Society 2006 Spring Meeting, San Francisco CA, USA, April 19, 2006.
38. S.-H. Liu, C.-H. Chang, B.K. Paul, V.T. Remcho, B. Abhinkar, "Synthesis of Dendrimers using Continuous Flow Microreactors, session 62 Polymerization in Micro-Reactors", AIChE Spring National Meeting, Orlando, FL, USA, April 24, 2006.
39. Y.-J. Chang, D.-H. Lee, C.-H. Chang, "Inkjet Printed Inorganic Channel Materials for Thin Film Transistors", M8.6, Materials Research Society 2005 Fall Meeting Symposium, Boston, USA, November, 2005.
40. C.-H. Chang, S.-H. Liu, Y. Tennico, J.T. Rundel, V.T. Remcho, E. Blackwell, T. Tseng, B.K. Paul, "Progress Towards Chip-Based High-Throughput Dendrimer Synthesis", IMRET 8<sup>th</sup> International Conference on Microreaction Technology, Atlanta, Georgia, USA, 2005.
41. S.-H. Liu, C. Jeffryes, G. L. Rorrer, C.-H. Chang, J. Jiao and T. Gutu, "Blue Luminescent Biogenic Silicon-Germanium Oxide Nanocomposites", presented at Materials Research Society 2005 Spring Meeting Symposium, "Biological and Bio-Inspired Materials and Devices", San Francisco, CA, USA, March, 2005.
42. Y.-J. Chang, D.-H. Lee, P. H. Mudgar, S. O. Ryu, T.-J. Lee, C.-H. Chang, "Growth Kinetics of Thin Film Electronic Materials via Soft Solution Processes", presented at session 366 Reaction Kinetics in Electronic Materials Processing, 2004 American Institute of Chemical Engineers Annual Meeting, Austin, TX, USA, November 2004.
43. C.-H. Chang, Y.-J. Chang, D.-H. Lee, S. O. Ryu, T.-J. Lee, "Characterization and Application of Semiconductor Thin Films Deposited by Chemical Bath", Microscopy and Microanalysis 2004, Savannah, Georgia, USA, August 2004.
44. G. Ma, C.-H. Chang, S. Yoon, R. Noufi, and T.J. Anderson, "X-ray Absorption Fine Structure Investigations of the Local Structure of Cadmium in CuInSe<sub>2</sub>-based Materials", presented at Symposium: Advances in Characterization of Inorganic Materials for Energy and Environmental Applications, 2003 American Institute of Chemical Engineers annual meeting, San Francisco, CA, USA, November 2003.
45. C. Jeffreys, S.-H. Liu, G. Rorrer, C.-H. Chang, "Biosynthesis of Silicon-Germanium Oxide Nanocomposites by Marine Diatoms," presented at Symposium: Biomimetics III, 2003 American Institute of Chemical Engineers annual meeting, San Francisco, CA, USA, November 2003.
46. M. Koretsky, C.-H. Chang, S. Kimura, S. Rochefort, "Getting Students to Approach Microelectronics Processing as a Chemical Engineer, presented at Symposium: Teaching Nanotechnology and Microelectronics", 2003 American Institute of Chemical Engineers Annual Meeting, San Francisco, CA, USA, November 2003.
47. Y.-J. Chang, D.-H. Lee, S.O. Ryu, T.-J. Lee, C.-H. Chang, "An Impinging Flow Reactor for the Chemical Bath Deposition", presented at Symposium: Film Growth of Electronic

- Materials, 2003 American Institute of Chemical Engineers Annual Meeting, San Francisco, CA, USA, November 2003.
48. C. Jeffreys, S.-H. Liu, G. Rorrer, C.-H. Chang, "Biosynthesis of Silicon-Germanium Oxide Nanocomposites by Marine Diatoms", presented at the 14<sup>th</sup> Pacific Northwest Chapter American Vacuum Society 2003 Annual Symposium, Troutdale, OR, USA, September 18 2003.
  49. N.-K. Park, J.-D. Lee, S.-O. Ryu, T.-J. Lee, J.-C. Kim, C.-H. Chang, "A Study on Deactivation of Zinc-Based Sorbents for Hot Gas Desulfurization", presented at the oral session 32.1 of the 20<sup>th</sup> Annual International Pittsburgh Coal Conference, Pittsburgh, PA, USA, September 2003.
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### **Peer-Selected Conference Poster Presentations**

1. Nova Wu, Tyler McCrea, Haori Yang, Gregory Herman, Han Mei, Chih-hung Chang, Stebby John, Microwave Synthesis of PbSe Quantum Dots and their Application for Detecting Ionizing Radiation: Nanomaterials, MS&T19 Portland, Oregon October 1, 2019.
2. Shujie Li, Alex Kosek, Shi-Joon Sung, Chih-hung Chang, Fabrication and Characterization of Inkjet-printed Cs<sub>2</sub>SnI<sub>6</sub> Thin Film for Optoelectronic Application, 11<sup>th</sup> International Symposium on Green and Sustainable Technologies for Materials Manufacturing and Processings – Poster Session, MS&T19 Portland, Oregon, October 1, 2019.
3. Yujing Zhang, Chih-hung Chang, Rapid, Additive Synthesis of Functional Metal-organic Framework Thin Films, Synthesis, Characterization, Modeling and Applications of Functional Porous Materials –Poster Session, MS&T19 Portland, Oregon, October 2, 2019.
4. Y. Zhang, X. Chong, H. Sun, M. Kedir, K.-J. Kim, P. R. Ohodnicki, A. X. Wang, C.-H. Chang, Localized Surface Plasmon Resonance Enhanced Carbon Dioxide Gas Sensing Based on Nanostructured Copper Sulfide Thin Films, the 29th Annual Symposium of the Pacific Northwest Chapter of the American Vacuum Society (PNWAVS) and SIMS USA 2018, Richland, WA, June 2018.
5. H. Sun, Y. Zhang, C.-H. Chang, Synthesis of Mg-MOF-74 thin film on optical support and its potential application in gas sensing the 29th Annual Symposium of the Pacific Northwest Chapter of the American Vacuum Society (PNWAVS) and SIMS USA 2018, Richland, WA, June 2018
6. D.S. Catherall, Z. Gao, C.-H. Chang, Microreactor assisted deposition of patterned CuO thin film for the enhancement of condensation, Pacific Northwest Chapter of the American Vacuum Society, Corvallis, OR, September 2017.
7. D. Chiu, Y. He, Z. Gao, C. Remple, C.-H. Chang, Pacific Northwest Chapter of the American Vacuum Society, Corvallis, OR, September 2017.
8. H. Mei, C.-H. Chang, Long silver nanowire synthesis and its application, Pacific Northwest Chapter of the American Vacuum Society, Corvallis, OR, September 2017.
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17. Dick Chiu, Changqing Pan, Chih-hung Chang, “Microreactor-Assisted Continuous ZnS Thin Film Deposition and Characterization”, 27<sup>th</sup> Annual Symposium of PNWAVS, Pacific Northwest National Laboratory, Richland, WA, USA, September 14-16, 2016.
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85. G. Ma, C.-H. Chang, S. Yoon, T.J. Anderson, C. Segre, J. Terry, T. Shibata, R. Noufi, "Extended X-ray Absorption Fine Structure Investigations of the Local Structure of Cd in Cu(InGa)Se<sub>2</sub> thin films", *Surface Analysis 04*, Richland, WA, USA, June 2004.
86. Y.-J. Chang, C. Munsee, J. Anderson, J.F. Wager, D. A. Keszler, C.-H. Chang, "Flexible CdS MISFET Fabricated by Low Temperature Solution-based Deposition Technique", presented at Session I7.1: Flexible Materials and Device Technology II, 2004 Materials Research Society Spring meeting, San Francisco, CA, USA, April 2004.
87. L. L. Kerr, T. J. Anderson, R. N. Noufi, K. Ramanathan, S.S. Li, S. Yoon, X. Wong, K. Kim, S. Kim, R. Kaczynski, R. Acher, C-H, Chang, O.D. Crisalle, "Rapid Thermal Processing of CIS Precursors", presented at Symposium: Materials Science and Engineering Division Poster Session, 2003 American Institute of Chemical Engineers annual meeting, San Francisco, CA, USA, November 2003.
88. R. Permanasari, C.-H. Chang, O. Crisalle, "Electrochemical Deposition of thin film CuGaSe<sub>2</sub> for Photovoltaics", presented at Symposium: Materials Science and Engineering Division Poster Session, 2003 American Institute of Chemical Engineers annual meeting annual meeting, San Francisco, CA, USA, November 2003.
89. J. Kroon, C.-H. Chang, F. Nwachukwu, B.-K. Paul, "Investigation of Microreaction Technology for the Production of Semiconductor Nanocrystals", presented at Symposium: Materials Science and Engineering Division Poster Session, 2003 American Institute of Chemical Engineers annual meeting annual meeting, San Francisco, CA, USA, November 2003.
90. C.-H. Chang, S.H. Wei, S.B. Zhang, J.W. Johnson, N. Leyarovska, G. Bunker, T.J. Anderson, "Local Structure of CuIn<sub>3</sub>Se<sub>5</sub>: X-ray Absorption Fine Structure Study and First-principles Calculation", presented in 13th Pacific Northwest American Vacuum Society Annual Symposium, Vancouver, WA, USA, September 2002.
91. S.-H. Liu, C. Jeffreys, G. Rorrer, C.-H, Chang, C. Wang, "Characterization of Biogenic Silicon-Germanium Oxide Nanocomposite", *Nanoscale Science and Technology Workshop*, Seattle, WA, USA, September 2003.

92. R. Permanasari, C.-H. Chang, O. Crisalle, “Electrochemical Deposition of thin film CuGaSe<sub>2</sub> for Photovoltaics”, presented at the 14th Pacific Northwest American Vacuum Society Annual Symposium 2003 Symposium, Troutdale, OR, USA, September 2003.
93. J. Kroon, C.-H. Chang, F. Nwachukwu, B.-K. Paul, “Investigation of Microreaction Technology for the Production of Semiconductor Nanocrystals”, presented at the 14th Pacific Northwest American Vacuum Society Annual Symposium, Troutdale, OR, USA, September 2003.
94. Y.-J. Chang, J. Kroon, D.-H. Lee, S.O. Ryu, T.-J. Lee, C.-H. Chang, “An Impinging Flow Reactor for the Chemical Bath Deposition”, presented at the 14th Pacific Northwest American Vacuum Society Annual Symposium, Troutdale, OR, USA, September 2003.
95. Giang Ma, S. Yoon, C.-H. Chang, R. Noufi, T.J. Anderson, “X-ray Absorption Fine Structure Investigations of the Local Structure of Cd in CuInSe<sub>2</sub>-based Materials”, presented at the 14th Pacific Northwest American Vacuum Society Annual Symposium, Troutdale, OR, USA, September 2003.
96. J. Kroon, C.-H. Chang, F. Nwachukwu, B.-K. Paul, “Investigation of Microreaction Technology for the Production of Semiconductor Nanocrystals”, IMRET 7- 7th International Conference on Microreaction Technology, Lausanne, Switzerland, 2003.
97. C. Jeffryes, S. Liu, C.-H. Chang, G.L. Rorrer, “Biosynthesis of Germanium Oxide by Marine Diatoms”, presented at the 225th American Chemical Society National Meeting, New Orleans, LA, USA, 2003.
98. C.-H. Chang, M. Koretsky, S. Kimura, S. Rochefort, C. Shaner, “Lab-based Unit Operations in Microelectronics Processing”, presented at the 13th Pacific Northwest American Vacuum Society Annual Symposium, Vancouver WA, USA, 2002.
99. C.-H. Chang, M. Koretsky, S. Kimura, S. Rochefort, C. Shaner, “Lab-based Unit Operations in Microelectronics Processing”, presented at the 13th ASEE summer school for Chemical Engineering Faculty, Boulder, CO, USA, 2002.
100. C.-H. Chang, B.J. Stanbery, G. Weerasekera, M. Huang, R. Duran, T.J. Anderson, “Structure and Phase Evolution during Rapid Thermal Processing for CuInSe<sub>2</sub> Thin Film Formation From a Multilayer Precursor”, presented at Symposium A., Materials Research Society Fall meeting, Boston, USA, 1999.
101. C.-H. Chang, B.J. Stanbery, A. Morrone, A. Davydov, T.J. Anderson, L. Rieth, P. Holloway, “CuInSe<sub>2</sub> Thin Films Formation by Rapid Thermal Processing”, presented at the 26<sup>th</sup> Annual Symposium Applied Vacuum Science and Technology, American Vacuum Society, Orlando, FL, USA, 1998.
102. C.-H. Chang, A. Davydov, B.J. Stanbery, T.J. Anderson, “Thermodynamic Assessment of Selenium Unary System,” presented at the CALPHAD (Computer Coupling of Phase Diagrams and Thermochemistry) XXVI, Palm Coast, FL, USA, 1997.
103. C.-H. Chang, C. McCreary, B.J. Stanbery, A. Morrone, A. Davydov, T.J. Anderson, “Growth and Characterization of CdS Thin Films by Chemical Bath Deposition and Metalorganic Chemical Vapor Deposition,” presented at the 25<sup>th</sup> Annual Symposium Applied Vacuum Science and Technology, AVS, Orlando, FL, USA, 1997.

- 104.A. Davydov, C.-H. Chang, T.J. Anderson, "Assessment of Thermochemical and Phase Diagram Data for Selected Compound Semiconductors," presented at 212<sup>th</sup> American Chemical Society National Meeting, Orlando, FL, USA, 1996.

### **News Media & Press Releases**

1. Oregon State lands \$810,000 grant from Walmart Foundation to spur textile innovations By Andrew Theen - The Oregonian/OregonLive on January 25, 2016.
2. Ceremony marks Wal-Mart grants By Bennett Hall Corvallis Gazette-Times May 26, 2016
3. Oregon State University receives \$810,000 grant from Walmart to research environmentally friendly dye By Greg Germano February 9, 2016 OSU Daily Barometer
4. Apparel Resources "Oregon State University To Develop Eco Friendly Dyes" January 29, 2016.
5. "Researcher finds new method for boiling water," Brad Anderson, The Daily Barometer, May 17<sup>th</sup> 2016.
6. "Innovative-water-boiling-approach-could-cool-advanced-electronics", Electronics Cooling, May 2016.
7. "Engineers Create a Better Way to Boil Water," PRODUCT DEVELOPMENT, MAY 05, 2016.
8. "Dyes for the future: OSU receives grant to research environmentally friendly dye," Jeremy Melamed, The daily barometer, Tuesday, February 9, 2016.
9. "Photonic-sintering-may-lead-to-advances-in-thin-film-solar-cells," Sandra Henderson, Research Editor, Solar Novus Today. 2015.
10. "Micro-reactor produces silver nanoparticles at room temperature for printed circuits", ASM International, July 09, 2015.
11. "Oregon researchers fabricate silver," David Manners, Electronics Weekly, July 2, 2015.
12. "Moths-inspire-anti-glare-coatings-that-grab-light-and-dont-let-go," www.wired.com, Nov 2015.
13. "New-printing-technology-for-depositing-silver-at-room-temperature-may-lead-to-electronics-advances," www.kurzweilai.net.
14. "Optics, nanotechnology combined to create low-cost sensor for gases," ScienceDaily, April 2, 2015.
15. "Optics, nanotechnology combined to create low-cost sensor for gases," David Stauth, OSU Press Release, April 2, 2015
16. "The Sun Performs Double Duty," Chemical Engineering Progress, P.15, May 2014.
17. "Energy breakthrough uses sun to create solar energy materials," David Stauth, OSU Press Release, April 3, 2014.
18. "Bright Idea," David Stauth, OSU Press Release, September 14, 2011.
19. "OSU Solar Vehicle Team and the Oregon Process Innovation Center (OPIC) Lab," Rick Coyle, Green Science Oregon, Episode 11, February 5, 2011.



20. "Bright Idea," Terra, Fall 2010.
21. "New OSU Solar Research Center to Open in May," Erik Siemers, Portland Business Journal, Sustainable Business Oregon, March 15, 2010.
22. "Solar Cell Research," Matt Templeman, KMTR-16, February 8, 2010.
23. "New Solar Reactor Facility to Open in Corvallis in Spring," Michelle Ofelt, The Daily Barometer, January 20, 2010.
24. "Solar Research Center May Spur innovation, Industry Development in Oregon," David Stauth, OSU Press Release, January 8, 2010.
25. "Inkjet Printing Could Change the Face of Solar Cell Industry," OSU Press Release, June 28, 2011.
26. "Project uses inkjets to produce solar cells," Grady Garrett, Gazette-Times, July 15, 2011.
27. "Inkjet printing solar panels: cheap and almost green," Bianca Seidman, PBS, July 12, 2011.
28. "Solar power cells produced via inkjet teck," Jasmine Greene, Reuters, July 6, 2011.
29. "Scientists use inkjet printing to produce solar cells," Katia Moskvitch, BBC News, June 30, 2011.
30. "OSU scientists find inkjet technology for solar cells," Christina Williams, Sustainable Business Oregon, June 28, 2011.
31. "OSU Solar Vehicle Team and the Oregon Process Innovation Center (OPIC) Lab," Rick Coyle, Green Science Oregon, Episode 11, broadcast February 5, 2011.
32. "New Thin Film Solar Cell Technology from Oregon State University," AzoCleantech, April 22, 2010.
33. "Advance made in 'thin film' solar cell technology," Nanotechnology News (press release), April 21, 2010.
34. "Advance made in 'thin film' solar cell technology", NanoScienceWorld, April 21, 2010.
35. "Advance made in thin-film solar cell technology", Science News, April 20, 2010.
36. "Solar Novus Today - Continuous Flow Microreactors Produce Thin Film Absorbers for Solar Cells", April 20, 2010.
37. "Solar Technology may be Much More Affordable in the Future", KEZI TV, April 20, 2010.
38. "Oregon State University Launches Solar Research Center", PV Society, Jan. 14, 2010.
39. "Solar research center may spur innovation, industry development in Oregon", Media Newswire, Jan. 11, 2010.
40. "Solar research center may spur innovation, industry development in Oregon", Nanotechnology News (press release), Jan. 8, 2010.
41. "Microreactor Speed Up Production of Nanoparticles, Chemical Engineering Progress", December 2010.
42. "Speedy Nanoparticles", Materials Today Page 13, Volume 13, Number 12, December 2010.
43. "Nanocoating Boosts Heat Transfer", Chemical Processing, <http://www.chemicalprocessing.com/articles/2010/173.html?page=print>

44. "Moth Eyes Inspire Better Optics", Kristina Mullins, Northwest Science and Technology, Spring 2010.
45. "Science *Daily*, New Nanostructure Technology Provides Advances un Eyeglass", Solar Energy Performance, September 29, 2009.
46. "Treehugger Michael Graham Richard, Ottawa, Canada Breakthrough Nano Tech Will Boost Solar Power Efficiency", September 16, 2009.
47. " Nanotechnology Provides Advances in Eyeglasses, Solar Energy", David Stauch, OSU Press Release, September 16, 2009.
48. "Materials science: Diatomic power", Nature Research Highlights Nature 453, 1146, doi:10.1038/4531146d, June 26, 2008.;
49. "En route to inkjet-printing transparent electronics and thin film solar cells", Nanowerk nanospotlight, March 20, 2007.
50. "Nanotech Gadgets to Be Built by Algae?" National Geographic News, March 29, 2005.
51. "Ancient Algae weaves electronics materials", The Washington Times, Aug 2, 2004.
52. "OSU professor earns CAREER grant", Corvallis Gazette-Times, February 13, 2004.
53. "Flexible electronics key to CAREER grant", The Daily Barometer, February 18, 2004.
54. "Intel names 2000 faculty fellows", Corvallis Gazette-Times, April 14, 2000.

## POSTDOCTORAL STUDENTS

### Major Professor: Postdoctoral Scholar

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Name & Degree		
Zhongwei Gao	Ph.D.	2020-2021
Yujuan He	Ph.D.	2018-2019
Changqing Pan	Ph.D.	2017-present
Ki-Joong Kim	Ph.D.	2011-2016
Chang-Ho Choi	Ph.D.	2013-2015
Yu-Wei Su	Ph.D.	2011-2012
Seung-Yeol Han	Ph.D.	2010-2012

## GRADUATE STUDENTS

### Major Professor: Current Graduate Students

4 Ph.D./ 4 M.S.

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Name	Degree	Thesis Topics	Date
Hsin-Mei Gao	Ph.D.	TBD	
Tzer-Rung Su	M.S.	TBD	
Jeffrey Dhas	M.S.	TBD	
Si-Hao Chen	M.S.	TBD	

Venkata Vinay Krishna Doddapaneni	Ph.D.	TBD
Han Mei	Ph.D.	TBD
Shujie Li	Ph.D.	TBD

**Major Professor: Former Graduate Students**

**17 Ph.D. / 23 M.S.**

Han Xu	MS	Low-Cost Light Trapping Layer via Melting Gel and Hot Embossing Technique	2021
Yujing Zhang	Ph.D.	Metal Organic Framework Thin Films: The Synthesis and The Application	2020
Zhongwei Gao	Ph.D.	Growth, Characterizations, and Applications of Patterned Nanostructured Thin Film	2019
Yujuan He	Ph.D.	Microreactor-assisted Synthesis of Hollow Silica and YVO <sub>4</sub> :Eu Nanoparticles for Retrofitted Multifunctional Thin Films for Solar Module Power Enhancement	2018
Ziyan Liu	M.S.	Interfacial Synthesis of Covalent Organic-Frameworks Membrane and Characterization	2018
Zeng Cheng	M.S.	Formation of Cu <sub>2</sub> ZnSnS <sub>4</sub> Thin Films via Reactive Sintering of Binary Metal-Sulfide Nanoparticles using via Intense Pulsed Light Sintering	2018
Yu Cao	M.S.	Fabrication of Biological Pigment Nanowires by Inkjet Printing	2018
Sun Hao	M.S.	Synthesis of Mg-MOF-74 thin film on optical support and its application in gas sensing	2018
Changqing Pan	Ph.D.	Solution-based Chalcogenide Thin Film Deposition	2017
Qun Jing	M.S	Down-Shifting Nanoparticles and Anti-reflective Nanoparticles Co-Coating Applied on Top Glass Cover of Silicon-Based Solar Panels	2016
Michele David	M.S	Experimental Study of Nucleate Boiling Dynamics and Heat Transfer Enhancement on Printed Bi-functional Surfaces	2016
Dick Chiu	Ph.D.	Growth, Characterization and Applications of Zinc Sulfide Thin Films by Solution-Based Processes	2016
Jenna Y. Gorecki	M.S	Low-temperature, Inkjet-printed Copper(I) Iodide-based p-Type Thin-Film Transistors	2016

Guoheng Ma	M.S.	Synthesis of Plasmonic-Enhanced Metal-Organic Framework Thin Films and their Infrared Sensing Application	2016
Fang Zeng	M.S.	Iron Chalcogenide-based Thin Films Fabricated by Inkjet Printing	2015
Peter Kreider (co-advisor with Yokochi)	Ph.D.	Applications of Nonthermal Microplasmas in Chemical Reaction Engineering	2015
Katherine Han (SunPower)	Ph.D.	Nanostructures for Solar PV Applications: Simulation and Fabrication	2014
Paravee Vas-Umnuay (Chulalongkorn University)	Ph.D.	Growth, and Characterization and Applications of Copper Sulfide Thin Films by Solution-Based Processes	2013
Chang-Ho Choi (Gyeongsang National University)	Ph.D.	Synthesis of Colloidal Metal Oxide Nanocrystals and Nanostructured Surfaces Using a Continuous Flow Microreactor System and Their Applications in Two-phase Boiling Heat Transfer	2013
Wei Wang (IBM)	Ph.D.	Fabrication of CuInGaSe <sub>2</sub> Thin Film Solar Cells using Low-cost Air-Stable Inks	2012
Yong Jun Li (Wafer Tech)	M.S.	Continuous Synthesis of Metal-organic Frameworks Under High Pressure	2012
Michael Knapp (OSU)	M.S.	Continuous Flow Synthesis of Lead Sulfide and Copper Indium Diselenide Nanocrystals	2012
Yu-Wei Su (Feng Chia University)	Ph.D.	CdS Nanocrystalline Thin Films Deposited by the Continuous Microreactor-Assisted Solution Deposition (MASD) Process: Growth Mechanisms and Film Characterizations	2011
Wei-Liang Yen (Amkor Technology)	M.S.	Synthesis of Titanium Dioxide Nanorods using a Continuous flow Microreactor	2011
Seung-Yeol Han (Pellucere Technology)	PhD	Investigation of Solution-based Processes for Functional Metal Oxides: Printing, Nanostructures, and Applications	2010
Hyundae-Dae Jin (Zymergen)	Ph.D.	Continuous and Rapid Synthesis of Nanoclusters and Nanocrystals using Scalable Microstructured Reactors	2010
Changho Choi (Gyeongsang National University)	M.S.	Fabrication of nanostructured surfaces for enhanced heat transfer	2009
Mark Hoskins (Hewlett Packards)	M.S.	Ag films from liquid precursors in a closed cell Microwave	2009

Wei Wang (IBM)	M.S.	Selective Self-Assembly of Biogenic Silica Assisted by Layer-by-Layer Deposition and Inkjet Printing	2008
Shu-hong Liu (Regeneron)	Ph.D.	Synthesis, Characterization and Deposition of Dendrimers using a Continuous Flow Microreactor	2007
Doo-Hyoung Lee (Samsung)	Ph.D.	Development of Solution-based Reaction Processes for Micro-and-Nano-Structured Semiconductors	2007
Yu-Jen Chang (Supermicro)	Ph.D.	Investigation of Low Temperature Solution-Based Deposition Process for Flexible Electronics	2007
Yu-Wei Su (Feng Chia University)	M.S.	Fabrication and Characterization of Ferrimagnetic Film for RF/Microwave Crosstalk Suppression	2007
Prakash Mugdur (Saint-Gobain)	M.S.	Continuous Flow Microreactor for Chemical Bath Deposition: A Novel Approach to the Deposition of Polycrystalline Semiconductor Thin Films	2005
Jiqing Hu (Microsoft)	Ph.D.	Growth and Characterization of Zinc Ferrite Thin Films for High Frequency Applications	2005
Shu-hong Liu (Regeneron)	M.S.	Characterizations of Silicon-Germanium Nanocomposites Fabricated by the Marine Diatom <i>Nitzschia frustulum</i>	2005
Joani Kroon (Hewlett Packard)	M.S.	Production of Monodispersed Semiconductor Nanoparticles via Microreactors	2004
Rina Permanasari (Wafer Tech)	M.S.	Electrochemical Deposition of Thin Film CuGaSe <sub>2</sub> for Photovoltaics	2004
Giang N. Ma (Micron)	M.S.	XAFS Investigation of the Local Structure of Cadmium in CuInSe <sub>2</sub> -Based Materials	2004
Curtis L. Voss (Hewlett Packard)	M.S.	Fabrication of a Cadmium Sulfide Thin Film Transistor Using Chemical Bath Deposition	2002

**Major Professor: Honor College Students**

Evan James Haning	B.S.	Investigation of Magnesium Dioxybenzenedicarboxylate (Mg-DOBDC) Thin-film Deposition onto Modified Glass Substrates	2019
Jeffrey Dhas	B.S.	Thermodynamics of Laser-Assisted Solution Combustion Synthesis of Yttrium Oxide	2020
Harrison R. Holzgang	B.S.	Inkjet Printing of Nanoparticle-based Anti-Reflective Thin Films	2015

Anna Putnam (Stanford University)	B.S.	Inkjet Printed Lithium Iron Phosphate Thin Films	2009
Nathan Coussen (Oregon State Univ.)	B.S.	Lanthanum Sulfide Thin Film Deposition via Microreactor-Assisted Nanoparticle Deposition	2009
Yosuke Yamamoto (JSR Micro.)	B.S.	Fabrication and Characterization of Metal- Semiconductor Field Effect Transistors on Polymeric Substrates by Chemical Bath Deposition Technique	2003

### **VISITING SCHOLARS**

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Title & Name

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Prof. Sun Yu	Department of Chemical Engineering, Tianjian University of Technology, Tianjian, China.
Prof. Si Ok Ryu	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Prof. Myung Yul Kim	Sunchon National University, Department of Polymer Science & Engineering, 315 Maegok, Sunchon, Jeonnam, 540-742, Korea
Prof. Seok-Kyun Noh	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Mr. Seung-Yeol Han	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Ms. Ji Young Jung	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Ms. Jin Young Lee	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Ms. Won Hae Choi	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Ms. Eun Jin Bae	School of Chemical Engineering and Technology, Yeungnam University, Kyongsan, Korea.
Dr. Ki-Joong Kim	Department of Chemical Engineering, Sunchon National University, Sunchon, Jeonnam, Korea
Prof. Hyukhyun Ryu	School of Nano Eng., Inje University, Korea
Prof. Yeon Hwang	Department of Materials Science and Engineering, Seoul National University of Science & Technology, Korea
Prof. Xiaojing Xu	College of Veterinary, Inner Mongolia Agricultural University, China
Dr. Dae Hwan Kim	Green Energy Daegu Kyeongbuk Institute of Science & Technology
Dr. Jin Kyu Kang	Daegu Kyeongbuk Institute of Science & Technology, 2015

Prof. Jie Liu	Dalian University, China, 2015
Gyu Hun Lee	Sunchon National University, South Korea, 2016
Prof. Zhong Chen	Jiangxi Science and Technology Normal University, China 2017
Cheul Ho Ha	Yeungnam University, South Korea, 2017
TaeHoon Kang	Yeungnam University, South Korea, 2017
Dr. Jaakko Leppäniemi	VTT, Finland, 2017
Dr. Shi-Joon Sung	Daegu Kyeongbuk Institute of Science & Technology, 2017
Dr. Chan-Hee Jung	Korea Atomic Energy Research Institute, Korea, 2017
Prof. Ping Li	Wuhan Institute of Technology, China, 2018
Changjin Son	Department of Chemical Engineering, Yonsei University, Korea, 2018
Taehyeon Kim	Department of Chemical Engineering, Yonsei University, Korea, 2019
Prof. Sangwoo Lim	Department of Chemical Engineering, Yonsei University, Korea, 2018

## **UNDERGRADUATE RESEARCHERS**

1. Mike Brooks (URISC Scholar)
2. Bradley Eagleson (2007-2010) (Johnson Summer Intern 2008)
3. Miri Goldade-Holbrook (2010) (Johnson Summer Intern)
4. Andrew Pfau (2011) (Johnson Summer Intern)
5. Kenneth Huang (2011) (Work Study)
6. Jameson Taylor (2012) (Johnson Summer Intern)
7. Karen Zhen (2013) (Johnson Summer Intern)
8. Janssen Levin (2013) (Johnson Summer Intern)
9. Elizabeth Alan-Cole (2014) (2nd year Johnson Summer Intern)
10. Gondhalekar, Vikram Baldini URISC Scholar (2014)
11. John Ren (2014)
12. McKenzie Kimball (2014)
13. Cassi Remple (2014) (Johnson Summer Intern)
14. Allen Marshall (2014) (Johnson Summer Intern)
15. Gregory Wu (2014 – 2015)

16. Cassi Remple (2014) (2<sup>nd</sup> year Johnson Intern)
17. Alvin Chang (2015, 2016 URISC Scholar)
18. Sung Ju lee (2015-2016)
19. Sarah Kim (2015) (U Notre Dame)
20. Austin Miller (2015) (Johnson Summer Intern)
21. Kaylee Rae (2015) (Johnson Summer Intern)
22. Al Isma'Ili, Al-Moatasem Hamood Ali 2015 2016
23. Austin Lassetter (2015- 2016)
24. Ziyue Zhu (2016)
25. Muaz Kedir (2016) Johnson Summer Intern
26. Riley Kendrick (2016) Johnson Summer Intern
27. Perrin C. Mao (2016)
28. Brendan Li. Marvin (2016, 2017)
29. Christian Nevo (2017)
30. Uzomah Nkwachi, Nwaigwe (2017)
31. Nathaniel Ung (2017-2019)
32. Joann Liu Moomaw (2017) Johnson Summer Intern, TRiO Research Scholarship
33. Catherall, David Spencer (2017) Johnson Summer Intern
34. Jay Choi (2017)
35. Aleksander Kosek (2017)
36. Chun, Bryan 2017-present
37. Guzman-Nader, Jorge Emmanuel (2018)
38. Mitchell Ho (2017, 2018)
39. Austin Ly
40. Sandra Li (2018-2020)
41. Andrew Gate (2018 Johnson Summer Intern), intern to 2019
42. Alekos Hovekamp (2018 Johnson Summer Intern), intern to 2019
43. Jeffrey Dhas (2018, 2019)
44. Evan James Haning (2018, 2019)
45. Ruan Wei (2018, 2019)
46. Liebe, Brayden R (2019 Johnson Summer Intern)
47. Rebarchik, Eric Robert (2019 Johnson Summer Intern)



48. Vicky Chang ChE (2020 Johnson Summer Intern)
49. Kevin Adams ChE (URSA 2021)
50. Elise Bennett ChE (URSA 2021)
51. Ethan Luong ChE (Johnson and URSA 2021)
52. Rhett Roberts ChE (URSA 2021)
53. Sophie Smith BioE (URSA 2021)
54. Lewis Beckett ChE (Johnson 2021)
55. Decesare, Cole Quentin Cole (Johnson 2021)

## **GRANTS and CONTRACTS**

The total award for all grants and contracts with C.-H. Chang as P.I. or Co-PIs is \$17.1 million.

### **a. Competitive, External Grant Awards**

1. More Power Less Dirt, DOE Solar Prize IV Set, Pellucere Technologies \$40,000, Gregory S. Herman, Chih-hung Chang, 2021
2. More Power Less Dirt, DOE Solar Prize IV Ready, Pellucere Technologies \$ 20,000, Gregory S. Herman, Chih-hung Chang, 2021
3. NSF PFI-RP, \$550,000, Novel 3D Nanomaterial Printer for Additive Manufacturing of Multiscale Materials, PIs: Chih-hung Chang, Brian K. Paul, Konstantinos Sierros, Somayeh Pasebani, \$550,000, 06/01/2020 - 05/31/2023.
4. Oregon Business Development Department, \$96,891.38 “Advanced Manufacturing: Leveraging Federal Investments in Modular Chemical Process Intensification to Expand the Metal 3D Printing Technology Industry within Oregon, Dec 31, 2019.
5. American Institute of Chemical Engineers, \$384,091 “Modular Chemical Process Intensification Institute for Clean Energy Manufacturing, 1/1/2017 - 12/31/2019.
6. Agricultural Research Foundation (ARF) Competitive Grants, \$12,483 “Paper-based Sensor for the Detection of Arsenic in Agricultural Water Sources, PIs: Elain Fu and Chih-hung Chang, Feb 1, 2018 – Jan 31, 2020.
7. National Science Foundation ECCS \$329,999, “Additive Photonic Nose: Toward System-On-Chip Optical Gas and Odor Sensing.” PI Alan X Wang, Co-PI Chih-hung Chang, 08/01/17-07/31/20.
8. Walmart Foundation \$800,000, “Sustainable Dyeing and Printing of Smart Fabrics using Environmentally Benign, Earth Abundant Inks,” PIs: Chih-hung Chang, Rajiv Malhotra, 01/31/2017 - 01/31/2020.
9. ONAMI GAP \$250,000 “Next Generation Active No-Fog Application,” PI. Chih-hung Chang, Co-PIs Greg Herman, Rajiv Malhotra 04/01/16-08/31/17.
10. National Energy Technology Laboratory \$50,000, “Fiber-Optic Technology for Downhole Measurement of Potential Groundwater Impacts,” PI: Chih-hung Chang, 05/01/16-07/31/16.

11. Walmart Foundation \$810,449, “Environmentally Conscious Dyeing of Fabrics Using Continuous Digital Printing of Biopigment Inks,” PI: Chih-hung Chang, co-PIs: Rajiv Malhotra, Sara Robinson, Hsiou-Lien Chen, 01/31/2016 – 01/31/2019.
12. National Science Foundation CMMI \$299,999, "Additive Manufacturing of Conformal Solar Cells via Xenon Light Assisted Sintering" PI: Rajiv Malhotra, co-PI Chih-hung Chang, 08/2015~07/2018.
13. DGIST \$30,892, "Develop Novel Solution-Based Precursors and Processes for High-Performance Earth Abundant Thin Film Solar Cells," PI: Chih-hung Chang, 06/11/2015 to 12/31/2015.
14. NSF REU \$10,000 "SNM: Physics-guided innovation of integrated flash-light-sintering, continuous nanomaterial synthesis and roll-to-roll deposition processes" PI: Chih-hung Chang, co-PIs: Rajiv Malhotra, Alan Wang, Greg Herman, 01/01/15-12/31/19.
15. NSF SNM, \$1,500,000, "SNM: Physics-guided innovation of integrated flash-light-sintering, continuous nanomaterial synthesis and roll-to-roll deposition processes" PI: Chih-hung Chang, co-PIs: Rajiv Malhotra, Alan Wang, Greg Herman, 01/01/15-12/31/19.
16. OSU Venture Fund, \$139,825, "Innovative Micro-and-Nanotechnology Enhanced Steam Generator/Boiler" PI: Chih-hung Chang, co-PI: Hailei Wang, 11/31/2014-12/01/2015.
17. NSF I-Corps, \$50,000, “I-Corps Demonstration of Microreactor-Assisted Nanomaterials Deposition for Customer Discovery and Value Creation,” Chih-hung Chang, 05/01/2014-10/31/2015.
18. Adams Communication & Engineering Tech/Army CERDEC, \$169,172.50, “System Optimizations and Performance Improvement on Heat Activated Cooling Systems based on Expander / Compressor Cycle, PI: Hailei Wang, Chih-hung Chang, 03/31/2014 to 09/11/2014.
19. DGIST \$42,000, “Develop Novel Solution-Based Precursors and Processes for High-Performance Earth Abundant Thin Film Solar Cells,” PI: Chih-hung Chang, 03/06/2014 to 12/31/2014.
20. NETL \$114,000, “Near-Infrared Absorption Sensors Using Plasmonic-Enhanced Nano-Composite Films for Fossil Energy Applications,” PIs: Alan Wang, Chih-hung Chang, 06/01/12-03/31/14.
21. NAVFAC-ARPA-E, \$746,359, (subaward from PNNL + ONAMI cost share to OSU), B.K. Paul, C. Chang and G. Herman, “Genset Heat Recovery Adsorption Chiller for Navy Forward Operations Bases,” 5/15/13-4/30/16.
22. NSF STTR Phase 2 Low-Cost Nanostructured Anti-Reflection Coating for Solar Energy Applications, CSD Nano and OSU, Total Award Amount: \$536,000 (NSF + ONAMI and Oregon BEST Cost Share), CSD Nano PI Paul Ahrens, OSU (\$215,000) PIs, Ken Williamson, C.H. Chang, B.K Paul, Award Period Covered: 10/29/12-12/31/17.
23. Oregon BEST, \$130,000 Proof-of-Concept of Energy Efficient Window Coatings, OSU and CSD Nano, OSU PIs Ken Williamson, C.H. Chang, B.K Paul, 01/01/13-09/01/13.
24. Oregon BEST, \$150,000, “Low Cost High Efficiency Concentration Optics for CPV” with Inspired Light, 06/01/12-12/31/12.

25. ONAMI GAP, \$247,900, “Nano-structured Anti-Reflective Coatings for Solar Cover Glass” with CSD Nano, OSU PIs Ken Williamson, C.H. Chang, B.K Paul, Award Period Covered: 09/01/11-06/30/13.
26. ONAMI-GAP “Microwave Assisted Continuous Flow Reactors” with Voxel Nano Inc., \$247,900. PI: G.S. Herman, Co-PI C.-H. Chang, Brian K. Paul, March 2010.
27. NSF EAGER/ONAMI/BEST: Production of Nanoscale Solar Energy Materials using a Solar Microreactor: \$110,000 PI: Chih-hung Chang, 01/01/2011-12/31/2011.
28. US Army CERDEC, Enhanced Transport on Nano-Coated Surfaces: Application to Absorption Cooling Cycle \$71,901 PI: Chih-hung Chang, 03/15/11-03/16/12.
29. DGIST: Develop a Low-cost Manufacturing Process for High Efficiency CIGS Thin Film PVs, \$170,000, PI Chih-hung Chang, 09/15/10-12/31/12.
30. MRI: Acquisition of a High Resolution Field Emission Transmission Electron Microscope at Oregon State University \$890,000 PIs: Vincent Remcho, John Conley, Mas Subramanian, Jamie Kruzic, Chih-hung Chang, 04/21/10.
31. NSF STTR Phase 1B/CSD Nano, Develop a Low-Cost Solution-Based Process of Nanostructured Anti-Reflection Coating for Solar Energy Applications, \$30K, PIs Scott Weaver, Gregory S. Herman, Chih-hung Chang, Brian K. Paul, Jimmy Yang. 07/01/10-06/30/11.
32. M. J. Murdock Charitable Trust, “Acquisition of Engineering Research Equipment for the ONAMI Microproducts Breakthrough Institute,” B.K. Paul, C. Chang, S. Leith and D. King, \$430K + \$1M in real dollar cost share (State of Oregon, OSU RO, MBI, various grants), 9/1/10-8/31/11.
33. Oregon BEST Acquisition and development of Quantum Efficiency Measurement Tooling for Process Optimization, \$355,000, PIs: Gregory S. Herman, Chih-hung Chang, 9/1/10-9/31/11.
34. ONR/ONAMI, Mechanism of Electrical Switching in Nanoscale Oxide Memristor Devices \$300,254 PIs: Gregory S. Herman, John Conley, Chih-hung Chang, S. Thevuthasan, 04/1/10-12/31/11
35. OSU Venture Fund, Demonstrate High Value Nanoparticle Synthesis, \$24,995 PIs. Greg Herman, Chih-hung Chang, Brian K. Paul.
36. NSF STTR Phase 1/CSD Nano, Develop a Low-Cost Solution-Based Process of Nanostructured Anti-Reflection Coating for Solar Energy Applications, \$159K, PIs Scott Weaver, Gregory S. Herman, Chih-hung Chang, Brian K. Paul, Jimmy Yang. 07/01/10-06/30/11.
37. US Air Force Office of Scientific Research/University of Oregon, Microsystem Development for Metal Nanoparticle Production, \$ 200,000 PIs: C.-H. Chang, B. K. Paul, V.T. Remcho, 10/01/09-09/30/10.
38. Oregon Process Innovation Center, Oregon BEST, \$282,000 (including OSU match 50K), PI: Chih-hung Chang, 2009.
39. US Army CERDEC, Towards Digital Fabrication of Surface Conformable Lithium Batteries, \$18,000 Chih-hung Chang, 2009.

40. US Army CERDEC, Nano-Structured Coatings on Microwicks for Enhanced Boiling Heat Transfer, \$70,000 Chih-Hung Chang, 2009.
41. Microchannel Assisted Nanomaterial Deposition Technology for Photovoltaic Material Production" U.S. DOE, Office of EERE ITP program, \$2.465,000 (including ONAMI match 300K) PNNL/OSU/ CH2M Hill/ Voxtel PIs: Dan Palo, Chih-hung Chang, Brian K. Paul, Vincent T. Remcho
42. US National Science Foundation, Graduate Research Supplement CAREER: Process Engineering of Chemical Bath Deposition-A soft Solution Route to Flexible Electronics. PI: C.-H. Chang, \$39,317, 12/31/08 –12/31/09.
43. OSU Venture Fund, Demonstrate High Efficiency Solar Cells by Inkjet Printing” \$19,997, PI: Chih-hung Chang 09/30/08-10/01/09.
44. Oregon BEST, \$75,000, Design and Control of a Microchannel-based Solar Receiver and Development of Scalable Catalytic Microchannel Reactors for Biofuels Processing, PI: Sourabh Apte, John Schmitt, Vinod Narayanan, Chih-hung Chang, Brian K. Paul 06/15/08-06/15/09.
45. US Army Research/University of Oregon, Micro/Nano-Structured Micro-Channel Heat Exchangers for Advanced Cooling, \$300,000. PIs. C.-H. Chang, B.K. Paul, T.J. Hendricks, D. Palo. 08/31/08-08/30/09.
46. US Army Research/University of Oregon, Drop-On Demand Fabrication of Li-Ion Batteries Using Ultra-Dry Inks, \$210,000. PIs. Rieke, Pederson, Viswanathan, Towne, Holbery, Chang, Chappell and Buckley 08/31/08-08/30/09.
47. US Air Force Office of Scientific Research/University of Oregon, Microsystem Development for Metal Nanoparticle Production, \$ 249,642 PIs: C.-H. Chang, B. K. Paul, V.T. Remcho, 10/18/05-04/18/09.
48. US Army Research/University of Oregon, Micro/Nano-Structured Micro-Channel Heat Exchangers for Advanced Cooling, \$160,000. PIs. C.-H. Chang, B.K. Paul, T.J. Hendricks, D. Palo. 10/15/07-3/15/08.
49. US Army Research/University of Oregon, Drop-On Demand Fabrication of Li-Ion Batteries Using Ultra-Dry Inks, \$90,000. PIs. Rieke, Pederson, Viswanathan, Towne, Holbery, Chang, Chappell and Buckley 10/15/07-3/15/08.
50. US National Science Foundation, Microreactor-Assisted Nanoparticle Deposition: An Efficient, Green Route to Functionally Gradient Films, \$299,265. PIs: B. K. Paul, C.-H. Chang, J. Yang, 06/15/07-09/01/10.
51. ONAMI GAP Fund, Demonstration of Microreactor-Assisted Nanomaterial Production, \$162,221, PIs: B. K. Paul, C.-H. Chang, 05/25/07-09/15/08.
52. US Air Force Office of Scientific Research/University of Oregon, Microsystem Development for Metal Nanoparticle Production, \$, 165,001 PIs: C.-H. Chang, B. K. Paul, V.T. Remcho, 10/18/05-04/18/09.
53. US Army Fort Belvoir Advanced Catalyst Fabrication Processing for the Economical Production of Catalytic Microreactors\$163, 705, PIs: C.-H. Chang, B. K. Paul, D. Palo, 01/01/07-12/31/07.

54. US Air Force Office of Scientific Research, Microsystem Development for Metal Nanoparticle Production, \$420,836, PIs: C.-H. Chang, B. K. Paul, V.T. Remcho, 9/1/05-8/31/06.
55. US National Science Foundation, NIRT: Whole-Cell Biosynthesis of Nanostructured Metal Oxide Semiconductors, PI: G. Rorrer, Co-PIs: C.-H. Chang and J. Jiao, \$1,300,000, 08/15/04–07/31/08.
56. US National Science Foundation, Novel, High Performance On-Chip Tunable Components and Crosstalk Suppression, PI: R. Settaluri, Co-PI: C.-H. Chang, \$180,000, 04/15/04–3/31/07.
57. W.M. Keck Foundation, MICRO2NANO: Microchemical 'Fractories' for the High-Yield Synthesis of Dendritic Nanoarchitectures. PI: C.-H. Chang Co-PI: B. K. Paul, V.T. Remcho, \$650,000, 01/15/04–12/31/06.
58. US National Science Foundation, CAREER: Process Engineering of Chemical Bath Deposition-A soft Solution Route to Flexible Electronics. PI: C.-H. Chang, \$400,000, 01/15/04–12/31/08.
59. US National Science Foundation, Flexible Thin Film Transistors Using Low Temperature Chemical Bath Deposition. PI: C.-H. Chang, \$70,000, 05/15/03 – 04/30/04.
60. US National Science Foundation, Biosynthesis of Germanium Oxide Nanoparticles. PI: Greg Rorrer, Co-PI: C.-H. Chang, \$100,000, 08/01/02 – 07/31/03.
61. US National Science Foundation, CCLI: Lab Based Unit Operations in Microelectronics Processing. PI: C.-H. Chang, Co-PIs: M.D. Koretsky, S. Rochefort, S. Kimura, C. Shaner, \$ 116,172, 03/15/02 – 03/15/03.
62. US Department of Energy National Renewable Energy Laboratory/University of Florida, X-ray Absorption Fine Structure Investigation of Local Structure of CIGS and the Na Related Compounds. PI: C.-H. Chang, \$ 60,000, 03/15/01 – 03/15/03.
63. US Department of Energy National Renewable Energy Laboratory/University of Florida, Develop Electrodeposition Process of CuGaSe<sub>2</sub> for Low Cost High Performance Tandem Solar Cell Application. PI: C.-H. Chang, \$ 18,000, 03/15/02 – 03/15/03.
64. US Department of Energy INEEL, Steam Reforming in Micro-reactors for Destruction of Hazardous Organic Materials. PI: G. Jovanovic, Co-PIs: C.-H. Chang, B.K. Paul, S. Rochefort, P. Watson, \$96,000, 01/01/01 – 09/30/02.

## **b. Industrial Awards and Contracts**

### **Industrial Gifts, Awards, and Contracts**

1. AU Optronics, \$80,000 "Develop solution-based P-type Semiconductor Channel Materials" PI: Chih-hung Chang, 05/01/14-05/01/15.
2. Sol Arrays LLC, \$6000, CIGS thin film solar cells, 2012-2013.
3. "Solution Processed CIGS Solar Cells," Sharp Laboratories of America Gift Funds, \$50,000. C.H. Chang, November 1, 2012.
4. "Solution Processed CIGS Solar Cells," Sharp Laboratories of America Gift Funds, \$80,000. C.H. Chang (\$40,000), G.S. Herman (\$40,000), April 1, 2012

5. "Solar Energy Research Using Microreactors," Sharp Laboratories of America Gift Funds, \$50,000. G.S. Herman (\$25,000), C.-H. Chang (\$25,000), April 1, 2011
6. "Solar Energy Research on Earth Abundant Materials," Sharp Laboratories of America Gift Funds, \$106,000. G.S. Herman (\$49,240), C.-H. Chang (\$49,240), B. Paul (\$7,520). April 1, 2010
7. "Solar Energy Research on Earth Abundant Materials," Sharp Laboratories of America Gift Funds, \$80,000. C.H. Chang (\$40,000), G.S. Herman (\$40,000), April 1, 2012
8. "Solar Energy Research Using Microreactors," Sharp Laboratories of America Gift Funds, \$50,000. G.S. Herman (\$25,000), C.-H. Chang (\$25,000), April 1, 2009.
9. "Solar Energy Research on Earth Abundant Materials," Sharp Laboratories of America Gift Funds, \$106,000. G.S. Herman (\$49,240), C.-H. Chang (\$49,240), B. Paul (\$7,520). April 1, 2008
10. Sharp Labs of Americas Gift Fund \$340,000.
11. AU Optronics Corporation, Printed Oxide TFT Research Award Amount: \$69,557.00. PI. Chih-hung Chang.
12. Levitronics, High efficiency hybrid solar collector and receiver, \$12,897, PI Chih-hung Chang 10/1/09-12/31/10.
13. Hewlett Packard Co. Thin-Film High-Performance Devices via Additive Processing, PI: D. Kezler, Co-PIs: C.-H. Chang and J. Wager, \$700,000, 09/15/04 – 09/14/06.
14. Hewlett-Packard Co. Printable Inorganic Materials for Flexible Electronics. PIs: C.-H. Chang, Doug Kezler, John Wager, \$252,202, 03/01/03 – 02/27/04.
15. Hewlett-Packard Co. Synthesis of Nanoparticle Solution for Printing. PI: C.-H. Chang \$5,000, 0/01/03 – 06/15/04.
16. Intel Co. Development of Unit Operation Education Modules for Multiple-Course Projects in Microelectronics Processing. PI: C.-H. Chang, Co-PIs: S. Kimura, M. Koretsky, M. Subramanian, C. McConica, \$ 50,000, 03/15/01 – 09/30/02.
17. Intel Co. Integrated Microelectronics Processing Program Phase II. PI: M. Koretsky, Co-PIs: C.-H. Chang, M. Subramanian, C. McConica, \$ 35,000, 06/15/00 – 06/15/01.

### **OSU Internal Competitive Awards for Research**

1. OSU/Research Equipment Reserved Fund. Scrubber System for Atomic Layer Deposition PI: C.-H. Chang \$ 27,493, 05/2005
2. Kelly Family Equipment Fund A Laser System Tunable from the Infrared to the Ultraviolet. PIs: W. Kong, C.-H. Chang, \$112,850, 12/18/ 2000 – 12/18/2002.
3. OSU General Research Fund. Pulse Nanocrystal Deposition by Thermal Ink Jet Technology and Applications to Fabrication of Flexible CuInSe<sub>2</sub> Thin Film Photovoltaics. PI: C.-H. Chang \$ 8,000 06/15/2002 – 06/15/ 2003
4. OSU/Research Equipment Reserved Fund. Acquisition of Electrochemical Interface for Teaching and Research. PI: C.-H. Chang \$ 5,950

5. OSU/Research Equipment Reserved Fund. Acquisition of an automated scanning monochromator for FLN and PLE measurements. PI: C.-H. Chang \$ 8,641

## TEACHING, ADVISING, AND OTHER ASSIGNMENTS

### 1. Instructional Summary

*Table B-1.* Summary of credit courses taught at Oregon State University

Undergraduate Courses & Times Taught		Graduate Courses & Times Taught	
ChE 311	16	ChE 537	14
ChE 412	1	ECE 511	1
ChE 312	1	ChE 599	3
ChE 450	6	ChE 550	6
<b>Total</b>	<b>24</b>	<b>Total</b>	<b>24</b>

### 2. Credit Courses (Reverse Chronological Listing)

OSU Course Number	Course Title	%	Cr.	Term	Year	Enrolled Students
ChE 311	Thermodynamics Properties & Relationship	30	3	Fall	2000	33
ChE 312	Chemical Engineering Thermodynamics	100	3	Winter	2001	34
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2001	33
ECE 511	Electronic Materials Processing	100	3	Fall	2001	33
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2002	51
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Spring	2002	6
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2003	40
ChE 412	Mass Transfer Operations	100	3	Winter	2004	7
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Spring	2004	13
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2004	47
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2005	3
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2006	61
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2007	17

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*Curriculum Vitae* for Chih-hung Chang

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ChE 599	Catalysis and Catalytic Process	100	4	Spring	2007	6
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2008	84
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Spring	2008	11
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2009	10
ChE 599	Catalysis and Catalytic Process	100	4	Spring	2009	6
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2009	93
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2010	19
ChE 599	Solar Cells: Devices, Materials and Processes	100	4	Spring	2010	10
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2010	104
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2011	15
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2011	121
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2012	22
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2012	148
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2013	16
ChE 450/550	Conventional and Alternative Energy	100	3	Spring	2013	56
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2013	148
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2014	28
ChE 450/550	Conventional and Alternative Energy	100	3	Spring	2014	60
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2014	149
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2015	29
ChE 450/550	Conventional and Alternative Energy	100	3	Spring	2015	69
ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2015	241
ChE 537	Chemical Engineering Thermodynamics I, II	100	4	Winter	2016	36
ChE 450/550	Conventional and Alternative Energy	100	3	Spring	2016	69

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ChE 311	Thermodynamics Properties & Relationship	100	3	Fall	2016	186
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### 3. Noncredit Courses and Workshops

Micro-Nano Technology & Engineering Development Workshop, Microproducts Breakthrough Institute (MBI)/Oregon State University July 20 to July 24, 2009.

### 4. Curriculum Development

#### Unique Efforts in Course Development, 2000-present

*Chemical Engineering Thermodynamics, CHE 311* – I have developed lectures, problems, in-class demonstrations, and in-class exercises to illustrate the principles of chemical engineering thermodynamics to chemical process and real life examples.

I have worked with CBEE school team to implement studio approach in 2011-2012 ChE 311 class. In particular, I developed 18 new worksheets for the studios and modified my lectures for this teaching approach.

Graduate Chemical Engineering Thermodynamics, *CHE 537* – I have incorporated molecular and statistical thermodynamics into this graduate level chemical engineering thermodynamics. Written and oral communications and projects were incorporated into the graduate chemical engineering thermodynamic course.

*Chemical Engineering Laboratory, CHE 414, 415* – I have developed laboratory modules using unit processes in new chemical engineering technologies to provide more opportunities for lab-based teaching. These modules are presenting to students as open-ended problems similar to a research project. The design of these laboratory modules are based on the synthesis of the research literature. I have collaborated with Profs. Koretsky, Kimura, Rochefort, and Hackleman to develop laboratory modules in the areas of microfabrication techniques (e.g. plasma etching, chemical mechanical planarization, electrodeposition, chemical vapor deposition, and spin coating) commonly used in the microelectronics industries and microreaction technology.

*Catalysis and Catalytic Process, ChE 541* – Catalysts and catalytic reactions are critical to both chemical and energy industry. There is no course in this area provided at OSU. To fill this gap, I have developed a graduate level catalysis course ChE 599 which I have taught successfully for two times. A category II proposal has been submitted to formally established ChE 541: Catalysis and Catalytic Process in the course catalog. This course covers topics related to catalysts and catalytic reactions including catalytic reaction mechanisms and kinetics, catalyst characterizations and activity testing, catalyst preparation and manufacturing processes. I have also designed hands-on projects to enhance the student learning experience.

*Solar Cells: Devices, Materials and Processes* – I have developed a graduate level solar cell course that were offered at spring 2010. This course introduces key solar cell technologies including silicon photovoltaics, thin film photovoltaics, dye sensitized cells and more advanced cell concepts to the students. The lectures cover devices, materials and processes associated with these PVs. Hands-on projects that offer students an opportunity to actually build and characterize solar cells were incorporated in this course.

I have worked with Prof. Jiyao Chen for his BA 458, “Innovation and New Product Development” for undergraduates. In this course, students study how to formulate innovation strategies such as selecting innovation projects, building collaboration partnerships, and protecting and leveraging IP, how to implement innovation strategies including new product development (NPD) processes such as identifying market opportunities, generating product concepts, testing and refining product concepts, and managing innovation teams, etc. Students are required to apply course materials to analyze a real NPD project to deepen students’ understanding and to improve their innovation capabilities. I have actively participated in this course in Spring 2012 by providing my IPs in the area of nanostructured antireflection coatings as a case for the business students. I worked with Prof. Chen to structure the course. The business students were exposed to the science behind the invention via my in-class presentations and interaction with them. The students were all exciting about the real world applicability of their assignment. At the end of the course, many student groups have come up with innovative ideas of new products for the IPs.

### 5. Team or Collaborative Teaching Efforts

I have co-taught ChE 414 with professors Skip Rochefort and Carol McConica during winter 2000 as a mentoring process for me to learn hand-on teaching.

I have co-taught ChE 311 with Professor Milo D. Koretsky during Fall 2000 as a mentoring process for me to learn the teaching techniques.

### 6. International Teaching

“Develop Solution-Based Processes for Flexible and Printed Electronics,” 2008 Flexible Electronics Seed Teacher Training Class, National Cheng Kung University, Tainai, Taiwan Aug 4-8, 2008.

### 7. Student and Participant/Client Evaluation Summary

Student evaluation for courses taught from Fall 2000 Winter to Spring 2003 are based on a 4.0 scale (4.0 is highest) are reported as average values. The number of students responding to the survey was equal to or less than the number of students enrolled in the course. The student evaluation is based on the average response to Question #12 of the student Assessment of Teaching form, which states “*All things considered, I was favorably impressed by this instructor.*”

Student evaluations for courses taught from Fall 2003 to present are based on a 6.0 scale (6.0 is highest). The student evaluation is based on the average response to Question #2, which states “The instructor’s contribution to the course was:”

#### ***Current Student Evaluation System, Fall 2003 to present (6.0 basis)***

						<b>Question #1</b>	<b>Question #2</b>
OSU Course Number	Course Title	Cr	Term	Year	No. Students	Student Eval. Mean	Student Eval. Mean

ChE 311	Thermodynamics Properties & Relationship	3	Fall	2003	40	5	5
ChE 412	Mass Transfer Operations	3	Winter	2004	7	5	5
ChE 537	Chemical Engineering Thermodynamics I, II	4	Spring	2004	13	5	5
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2004	47	4.5	4.5
ChE 537	Chemical Engineering Thermodynamics I, II	4	Spring	2005	3	5.1	5.2
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2005	47	4.3	4.4
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2006	61	4.8	5.0
ChE 537	Chemical Engineering Thermodynamics I, II	4	Fall	2006	17	5.0	5.4
ChE 599	Catalysis and Catalytic Processes	4	Spring	2007	6	5.0	5.3
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2007	84	4.7	4.9
ChE 537	Chemical Engineering Thermodynamics I, II	4	Winter	2008	11	5.1	5.2
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2008	93	4.3	4.6
ChE 537	Chemical Engineering Thermodynamics I, II	4	Winter	2009	10	4.9	5.0
ChE 599	Catalysis and Catalytic Processes	4	Spring	2009	6	5.9	6.0
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2009	83	4.3	4.6

ChE 537	Chemical Engineering Thermodynamics I, II	4	Winter	2010	19	5.6	5.8
ChE 599	Solar Cells: Devices, Materials and Processes	4	Spring	2010	10	5.6	5.4
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2010	104	4.7	4.8
ChE 537	Chemical Engineering Thermodynamics I, II	4	Winter	2011	15	5.0	5.3
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2011	121	4.5	4.5
ChE 537	Chemical Engineering Thermodynamics I, II	4	Winter	2012	22	5.1	5.3
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2012	148	4.5	4.5
ChE 537	Engineering Thermodynamics I, II	4	Winter	2013	16	5.3	5.5
ChE 450/550	Conventional and Alternative Energy	3	Spring	2013	56	5.5	5.5
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2013	148	4.8	5.0
ChE 537	Engineering Thermodynamics I, II	4	Winter	2014	28	5.8	5.8
ChE 450/550	Conventional and Alternative Energy	3	Spring	2014	56	5.6	5.5
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2014	150	4.9	5.0
ChE 537	Engineering Thermodynamics I, II	4	Winter	2015	29	5.5	5.5
ChE 450/550	Conventional and Alternative Energy	3	Winter	2015	70	5.5	5.5

ChE 311	Thermodynamics Properties & Relationship	3	Fall	2015	241	4.1	4.0
ChE 537	Engineering Thermodynamics I, II	4	Winter	2016	36	5.8	5.8
ChE 450/550	Conventional and Alternative Energy	3	Spring	2016	59	5.7	5.5
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2016	186	4.8	5.0
ChE 537	Engineering Thermodynamics I, II	4	Winter	2017	36	5.3	5.4
ChE 450/550	Conventional and Alternative Energy	3	Spring	2017	59	4.9	5.1
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2017	215	4.8	4.8
ChE 450/550	Conventional and Alternative Energy	3	Winter	2018	52	5.3	5.3
ChE 537	Engineering Thermodynamics I, II	4	Spring	2018	18	5.4	5.6
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2018	191	4.2	4.5
ChE 450/550	Conventional and Alternative Energy	3	Winter	2019	69	5.2	5.3
ChE 537	Engineering Thermodynamics I, II	4	Spring	2019	14	5.8	6.0
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2019	214	4.5	4.6
ChE 450/550	Conventional and Alternative Energy	3	Winter	2020	78	5.0	5.3
ChE 537	Engineering Thermodynamics I, II	4	Spring	2020	15	COVID	COVID
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2020	185	NA	NA
ChE 450/550	Conventional and Alternative Energy	3	Winter	2021	69	5.6	5.7

	Engineering						
ChE 537	Thermodynamics I, II	4	Spring	2021	22	5.5	5.4

**Previous Student Evaluation System, Fall 1989 to Spring 2003 (4.0 basis)**

						<b>Question #12 (4.0 basis)</b>	
OSU Course Number	Course Title	Cr.	Term	Year	No. Students	Student Eval.	
ChE 312	Chemical Engineering Thermodynamics	3	Winter	2001	34	3.35	
ChE 537	Chemical Engineering Thermodynamics I, II	4	Spring	2001	6	3.44	
ECE 511	Electronic Materials Processing	4	Fall	2001	33	2.89/OSU 4.0/OCATE	
ChE 537	Chemical Engineering Thermodynamics I, II	4	Spring	2002	8	3.88	
ChE 311	Thermodynamics Properties & Relationship	3	Fall	2002	51	2.86	
ChE 537	Chemical Engineering Thermodynamics I, II	4	Spring	2003	12	3.58	

**8. Advising**

From 2002 to present, I serve as the academic advisor for a mix of 25-30 undergraduate chemical engineering students of freshman, sophomore, junior, and senior standing. Individual advising and counseling sessions focus on discussion of class schedule for the following term, charting student progress toward satisfaction of degree requirements, and career/personal counseling.

Term	Year	Task	#Clients	Time per Client
F, W, S	02-03	Individual Advising	25-30	15 min
F, W, S	03-04	Individual Advising	25-30	15 min
F, W, S	03-04	Individual Advising	25-30	15 min
F, W, S	04-05	Individual Advising	25-30	15 min

F, W, S	05-06	Individual Advising	25-30	15 min
F, W, S	06-07	Individual Advising	25-30	15 min
F, W	07-08	Individual Advising	25-30	15 min
F, W, S	08-09	Individual Advising	25-30	15 min
F, W, S	09-10	Individual Advising	25-30	15 min
F, W, S	10-11	Individual Advising	25-30	15 min
F, W, S	11-12	Individual Advising	25-30	15 min
F, W, S	12-13	Individual Advising	25-30	15 min
F, W, S	13-14	Individual Advising	25-30	15 min

## SERVICE

### 1. Departmental Service

#### Undergraduate Advising

Advisor for 25 undergraduate students (freshman-senior), 2003-present

#### School, of Chemical, Biological and Environmental Engineering (CBEE)

#### Committees

1. Chair, Graduate Committee, 2015 - present
2. Member, School Head Search Committee, 2013-2014
3. Member, Johnson Building Planning Committee, 2013
4. Member, Faculty Status Committee, 2013-present
5. Member, Graduate Committee, 2011- 2015
6. Faculty Status Committee, 2011-2012
7. Chair, Graduate Committee, 2009 – 2011
8. Member, Status Committee, 2007 – 2009
9. Member, Graduate Committee, 2007 – 2009
10. Member, Curriculum Committee, 2005 – 2006
11. Chair, Computer and Facility Committee, 2004-2005
12. Member, ChE Graduate Committee, 2003-2005

13. Member, Computer and Facility Committee, 2004-2005

14. Member, CHE Vision Committee, 2000

## 2. College Service

ONAMI (Oregon Nanoscience and Microtechnology Institute) Nano/Micro Fabrication Facility Steering Committee

### International Exchange Program

I have established a formal exchange program with Yeungnam University, South Korea and National Taiwan University, Taipei Taiwan. These programs offer opportunities for our students to study and do research in top-rank Asian Universities and to get exposure to Asian culture, the social stimulation of a large city, and the perspective of a major technology center for the Far Eastern Asia.

## Service to the Profession

### Oregon Process Innovation Center (OPIC) for Sustainable Solar Cell Manufacturing

The PV industry has seen 40% annual growth, despite suffering from high costs, consuming large amounts of energy, providing low solar capture efficiency, employing hazardous materials, and operating with poor material utilization efficiencies. To address many of these concerns, I have helped establish the Oregon Process Innovation Center (OPIC) for Sustainable Solar Cell Manufacturing to support and enhance the rapid growth of solar cell manufacturing companies in Oregon. The center focuses on developing solar cell manufacturing methods that are environmentally benign, economical, and energy-efficient. The center is located within the Microproducts Breakthrough Institute to leverage existing operating strategies for the commercialization of university intellectual property.

OPIC is a collaborative center for the research, development and commercialization of sustainable manufacturing technologies within the PV industry. OPIC provides an environment for industrial and academic researchers to collaborate in the development of innovative processes for reducing the costs and environmental impacts of PV manufacturing. Capabilities in the center include the staff and expertise to conduct benchtop development and in-process characterization. Plans are moving forward to install pilot production facilities within OPIC in the coming year to prove out bench-scale technologies at pilot scale. To facilitate this, OPIC is developing a network of strategic industrial partnerships to ensure that these pilot-scale facilities can be scaled-up at production quantities. Current OPIC capabilities include the development of novel cross-cutting manufacturing technologies for current PV products (optimization, waste and cost reduction) as well as exploratory research and development for future PV product development. The center will provide opportunities to conduct industrial-scale manufacturing process problem solving as well as a training ground for the future PV workforce.

## Graduate Council Representative and Thesis Committee

Name	Degree	Thesis Titles	Date
Yu-An Huang	Ph.D.		



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*Curriculum Vitae* for Chih-hung Chang

Yi-Chia (Grace) Lin	Ph.D	TBD	
Rachelle M. Smith	Ph.D.	TBD	
Ming-Ji Hong	Ph.D.	TBD	
Ye Liu	Ph.D.	TBD	
Yeasmin, Sanjida	Ph.D.	TBD	
Bo Wu	Ph.D.	TBD	
Maoyu Wang	Ph.D.	TBD	
Joe Kraai	Ph.D.	Intensified cultivation and carbon uptake of red macroalgal clonal shoot tissues immobilized on stationary porous mesh panels	2021
Harish Devaraj (Rutger University)	Ph.D.	Modeling and Process Innovation in Nanowire Fusion	2021
Sweta Mahapatra	M.S.	Understanding the durability of wood-based composites using fracture toughness	2020
Zhongliang Xie	Ph.D.	Tsunami Loading on Coastal Infrastructure	2020
Kofi Oware Sarfo	Ph.D.	Predicting the Effect of Local Conditions on Metal-oxides: Pt/ $\gamma$ -Al <sub>2</sub> O <sub>3</sub> Interface and Degradation of " $\alpha$ -Cr <sub>2</sub> O <sub>3</sub> Passive Film.	2020
Jordan Pommereck	Ph.D.	Advancing Renewable Gas Storage using Flat-histogram Method	2020
Venkata Rajesh Saranam	Ph.D.	Foam-Core Meniscus Coating and Diffusion Bonding for Energy Applications	2020
Yan Wang	M.S.	Study of Garnet Type Electrolyte Li <sub>7</sub> La <sub>3</sub> Zr <sub>2</sub> O <sub>12</sub> Structure and Electrochemical Performance	2019
Joe Kraai	M.S.	Nanostructured Diatom Biosilica Stationary Phase for Thin-layer Chromatography Separation of Polar, Ionic Analytes	2019
Qin Pang	Ph.D.	Density Functional Theory Study of the Reaction Mechanism of Chloride-induced Depassivation of Iron Oxide Films	2019
Seyyed Yahya Mousavi	Ph.D.	Investigation of Epoxy-based Wood Adhesives	2019
Dan Huang	Ph.D.	An Investigation on Modeling the Effect of Catalyst Support on Bio-Hydrogenated Diesel Production Using Density Functional Theory	2019
Paul LeDuff	Ph.D.	Studies of Chitin Nanofiber Production and Photoluminescent Biosilica from Diatoms with and without Germanium	2019

Prajwal Prakash Adiga	M.S.	Hydraulic Jump Dynamics for Water Jet Impingement on Vertically Oriented Rotating Surfaces	2018
Omar Guillermo Chiriboga Novillo	Ph.D.	Nutrient Addition Strategies for the Marine Diatom <i>Cyclotella</i> sp to Control Cell, Lipid, and Chitin Formation	2018
ShiWen Li	M.S.	Investigation of Infrared Absorption of Carbon Dioxide in Metal-Organic Framework (MOF) Material	2018
Pei Lun Zhang	M.S.	Dechlorination of Chlorinated Phenols in Microscale Based Reactor; Mathematical Modeling, and Numerical Simulation	2018
Peter Ferrero	M.S.	Steady-State Diffusion in a Spatially Varying Porous Medium	2018
Akash Kannegulla	Ph.D.	Quantum Dot Plasmon Coupling: Fundamental Study and Applications	2018
Ryan T. Frederick	Ph.D.	Metal Oxide Cluster Chemistries for Next Generation Nanomanufacturing	2018
Lynza Halberstadt	Ph.D.	Analyzing the Kinetics and Thermodynamics of Surface Reactions using Density Functional Theory	2018
Yonggui Xie	Ph.D.	Enhancing Design of Geosynthetic-Reinforced Soil Supporting Spread Footings	2017
Weinan Zhao	M.S.	Density Functional Theory Study of CO <sub>2</sub> Dissociation on Nickel and Nickel Based Alloy Surface	2017
Xingyuan Chong	Ph.D.	Surface-Enhanced Infrared Absorption Gas Sensing Incorporating Advanced Plasmonic Nanostructures and Nano-Composite Materials	2017
Tang Longteng	Ph.D.	Femtosecond Stimulated Raman Studies of Excited State Structural Events	2017
Shalu Bansal	MS	An Investigation on Nanoscale-Shape-Mediated Coupling Between Temperature and Densification in Intense Pulsed Light Sintering of Silver Nanoparticles	2017
Clement Bommier	Ph.D.	Venturing Beyond Crystallinity and Into Amorphous Space: a Na-ion Battery Perspective	2017
Cheng Li	Ph.D.	Elucidation of Electrical Conductivity in Mixed-species Biofilms for Enhancing Energy Generation in Engineered Anaerobic Microbial Systems	2017

Gustavo Albuquerque	Ph.D.	Continuous Flow Microwave-assisted Synthesis as a Potentially Scalable Nanomanufacturing Approach	2017
Andrew J. Pfau	MS	Characterization of CoGe Thin Films and Powders	2016
Ye Liu	MS	Quantum Dot-Fullerene Based Molecular Beacons for Highly Sensitive DNA Detection	2016
Chang Li	Ph.D.	Use of Fine Lightweight Aggregate (FLWA) to Mitigate Alkali-Silica Reaction and Experimental and Numerical Modeling Approach to Elucidating Damage Mechanisms in Cement Well Casing-Host Rock Settings for Underground Storage of CO <sub>2</sub>	2016
Justin Pommerenck	Ph.D.	Nonthermal Plasma Microreaction Engineering for Gas and Liquid Processing	2016
Amila U. Liyanage	Ph.D.	Synthesis of Intercalation Compounds and Nanocomposites of Inorganic Layered Hosts	2015
Kate, Kunal Hemant	Ph.D.	Material Properties in Ceramic Injection Molding Design	2015
Malachi Bunn	Ph.D.	Aging and Performance Evaluation of Marine Antifouling Coatings	2015
Daniel Peterson	Ph.D.	Fluidic and Thermal Modeling for the High Production Rate Synthesis of High Quality Nanoparticles	2014
Rajesh Saranam	Ph.D.	Dissipation and wavepacket collision in carbon nanotube waveguides	2013
Brian Johnson	Ph.D.	Electronic and Optical Properties of Organic Semiconductors : Experiment and Simulation	2015
Richard P. Olesak	Ph.D.	Solution-Based Nanomaterials and Thin Films for Next Generation Electronics	2014
Brendan Flynn	Ph.D.	Functional materials for advanced energy and electronic devices	2014
Zhou Zheng	M.S.	Studies on effect of stabilizers, chelators and inherent periodicity on nanoparticle antioxidant activity	2014
Yihao Du	M.S.	Model programming of a direct contact condenser in solvent free microwave extraction of peppermint oil	2014
Yili Wu	M.S.	Pressure Sensitive Adhesive Based on Oleic Acid	2014

Kevin Caple	Ph.D.	Detailed Analysis of the Hydrogen Sulfide production Step in a Sulfur-Sulfur Thermochemical Water Splitting Cycle	2014
Chris J. Durgan	M.S.	Solution-Based Deposition of Functional Thin Films: Development of a Glucose Biosensor and Processing of nanoparticle Thin Film	2013
Fang-Yu Lee	M.S.	Method development for characterizing the hydrophobicity of engineered nanoparticles	2013
Eric Hostetler	M.S.	Processing of Nanoscale Materials: Microwave Synthesis of PbSe Nanocrystals and Thermal Oxidation of Zr-Cu-Al-Ni Metallic Glass	2013
Xiangru Fan	M.S.	Finite Volume Method modeling of corona discharge microractor oxidization of dibenzothiophene	2013
Barath Palanisamy	Ph.D.	Micromixer assisted continuous flow synthesis of nanoparticles of binary compounds and their application	2013
Ravindranadh Eluri	Ph.D.	Nanoparticle-Assisted Diffusion Brazing of Metal Microchannel Arrays: Nanoparticle Synthesis, Deposition and Characterization	2012
Hui Nian	Ph.D.	Investigation on Chemopreventive Mechanism for Methylselenocysteine Deaminated Metabolite Methylselenopyruvate as Histone Deacetylase Inhibitor	2010
Lisa Troung	Ph.D.	Developing Rapid <i>in Vivo</i> Assays to Investigate Structure-Activity Relationships	2011
Matthew A. Delaney	MS	Study of Graphite-Polyurethane Composite Thin Film Electrodes for Their Use in Electrochemical Antifouling Systems	2011
Justin Ong	M.S.	Impurity effect on magnetism of nickel for under bump metallization via magnetron sputtering	2010
Kasidid Asumpinpong	M.S.	Development of a Microchannel Device for Adsorption Cooling Application	2009
Santosh Tiwari	Ph.D.	Nickel Nanoparticle-Assisted Diffusion Brazing of Stainless Steel Surfaces for Microfluidic Applications	2010
Robert Kimmell	M.S.	Syntheses and Characterization of Nano Sized Iron Particles	2009
James Parker	Ph.D.	A Novel Lattice Boltzmann Method for Treatment of Multicomponent Convection, Diffusion, and Reaction Phenomena in Multiphase Systems	2008

Nick AuYeung	Ph.D.	Hydrogen Production via a Sulfur-Sulfur Thermochemical Water-Splitting Cycle	2011
Debra K. Gale	Ph.D.	Immunocomplex Sensing Using Antibody-Functionalized Diatom Biosilica Containing Photoluminescent Germanium	2011
Aaron Goodwin	Ph.D.	Conversion of Biomass Constituents to Hydrogen-rich Gas by Supercritical Water in a Microchannel Reactor	2010
Clayton Jeffryes	Ph.D.	Biological Insertation of Nanostructured Germanium and Titanium Oxides into Diatom Biosilica	2009
Yolanda Tennico	PhD	Magnetic particles for selective extraction of trace analytes in microfluidic devices	2010
Esha Chatterjee	PhD	Sensitive biomarker detection using liposomes encapsulating quantum dots as labels	2011
TaeHyeong Kim	Ph.D	Organic solvent Resistant Ultrafiltration and Nanofiltration Membrane Modules for Separation and Purification of Nanoparticles	2011
Seunghwa Kwon	Ph.D.	Effects of doping, cation stoichiometry, and the processing conditions on the dielectric properties of high-K $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ ceramics	2008
Myra Koesdjojo	Ph.D.	Fabrication and Application of Polymeric Based Microfluidic Devices	2009
Paravee Vas-Umnuay	M.S.	Flow characterization of multiple-tube reactors for synthesis of nano-sized silicon nitride powder via silicon monoxide ammonolysis	2008
Ayako Nakagawa	MS	Catalytic chemical vapor deposition synthesis of carbon nanotubes from methane on SiO supported Fe and Fe-Ni catalysts	2008
Seunghwa Kwon	PhD	Influences of Doping and Stoichiometry on the Dielectric Properties of High-K $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$	2007
Bindiya Abhinkar	MS	Modeling and Development of Fabrication Method for Embedding Membrane Based Microvalve in Bulk Microfluidic Device	2007
Carmen A. Velasco	MS	Microwave extraction of peppermint oil and comparison to the current practice of steam extraction	2007
YongJae Choi	M.S.	Cellulose Nanocrystal in the Carboxymethyl Cellulose Composites	2005
Michiru Hirayama	M.S.	Synthesis of Nano-Sized Silicon Nitride Powder in Microchannel Reactors	2006

Carlos Cruz-Fierro	Ph.D.	Hydrodynamic Effects of Particle Chaining in Liquid-Solid Magnetofluidized Beds: Theory, Experiments, and Simulation	2005
Clayton Jeffryes	M.S.	Kinetics of Nanoscale Ge and Si Assimilation into the Cell Wall of the Marine Diatom <i>Nitzschia frustulum</i>	2005
Arjun Venkataraman	M.S.	Etching of Polyphenylene Oxide in a Downstream Microwave Plasma using NF <sub>3</sub> , SF <sub>6</sub> , O <sub>2</sub> and Ar Gas Mixtures	2004
Ali H. Al-Raie	M.S.	Desulfurization of Thiophene and Dibenzothiophene with Hydrogen Peroxide in a Photochemical Microreactor	2005
Ahmad A. Al-Dhubabian	M.S.	Production of Biodiesel from Soybean Oil in Micro Scale Reactor	2005
Soujanya Vuppala	M.S.	Radiation Effects in III-V Heterojunction Bipolar Transistors	2004
Diana Djokotoe	M.S.	Burning Emulsified Sulfur to Stabilize Sodium Compounds in a Lime Kiln	2004
Seung Yoo	M.S.	MyTeam Portal: Integrating Exchange Web Applications with Rainbow Portal Framework	2003
David Hu	M.S.	Fault Probability and Confidence Interval Estimation of Random Defects seen in Integrated Circuit Processing	2003
Hai Q. Chiang	M.S.	Development of Zinc Tin Oxide-based Transparent Thin Film Transistor	2003
Carlos Cruz-Fierro	M.S.	Coupled Momentum and Heat Transport in Laminar Axisymmetric Pipe Flow of Ferrofluids in Non-uniform Magnetic Field: Theory and Simulation.	2003
Taran V. Harman	M.S.	Ferroelectric Thin Film Development	2003
ChyiShiun Li	M.S.	Radiation Effects in III-V Compound Semiconductor Heterostructure Devices	2003
Ploenpun Sakrittichai	M.S.	Dechlorination of p-Chlorophenol on a Palladium based Support Catalyst in a Microreactor; Experiment and Theory	2001
Wimol Lertwiwattrakul	M.S.	Fabrication of Ultrathin SiC Film Using Grafted Poly(methylsilane)	2000
Thana Sornchamni	M.S.	The Production of Voidage Distribution in a Non-uniform Magnetically Fluidized Bed: Theory and Experiment	2000

## MENG

1. Robertha Howell, 2009

2. Benjamin Zoladz, 2010
3. Nahad Alshareif, 2011
4. Aaron Williams, 2012
5. Rachel Beckman, 2012
6. Yaodong Zhang, 2014
7. Zelong Zeng, 2014
8. Jordan Reaksecker, 2015
9. Basil Al Saihati, 2015
10. Ji Feng, 2015
11. Christopher King, 2015
12. Dan Zhu, 2015
13. Jiajia Wu, 2015
14. Xinyu Cui, 2016
15. Jianyuan Dong, 2016
16. Shuping Li, 2016
17. Pengcheng Qiao, 2016
18. Hao Huang 2018
19. Ho Nam Chan 2018
20. Yu-Hsuan Ko 2019

### **Honors BS Committee**

Derek Wong (2018)  
Justin T. Tran (2017)  
Blake Lopez (2020)  
Renuka Bhatt (2021)

### **Conference Leadership**

1. Chair, PNWAVS 2011 Symposium, Wilsonville OR, September 2011.
2. Workshop Co-Chair and Organizer, the 11<sup>th</sup> Emerging Information & Technology Conference, University of Chicago, 2011.
3. Vice Chair, PNWAVS 2010 Symposium, EMSL Richland WA, September 2010.
4. Workshop Co-Chair and Organizer, the 10<sup>th</sup> Emerging Information & Technology Conference, Stanford University, 2010.
5. Organizing Committee: PNWAVS 2009 Symposium, September 2009, Troutdale OR.
6. Session Chair, AM-FPD 09, Nara, Japan, July 2009.

7. Session Chair, Digital Fabrication 2006, Denver, September 2006.
8. Chair, Poster session: Materials Science and Engineering Divisions, AIChE 2006 annual meeting, San Francisco, CA.
9. Chair, Poster session: Materials Science and Engineering Divisions, AIChE 2005 annual meeting, Cincinnati, OH.
10. Chair, Advances in Nanolithography, AIChE 2005 annual meeting, Cincinnati, OH.
11. Organizing Committee, 16<sup>th</sup> PNWAVS 2005 Symposium, September 2005, Troutdale OR.
12. Co-Chair, Poster session, Materials Science and Engineering Divisions, AIChE 2004 annual meeting, Austin TX.
13. Co-Chair, Chemical Vapor Deposition, AIChE 2004 annual meeting, Austin TX.
14. Organizing Committee, 26th Annual Symposium on Applied Surface Analysis, 2004, Richland WA.
15. Co-Chair, Poster session, Materials Science and Engineering Divisions, AIChE 2003 annual meeting American Institute of Chemical Engineers, Nov, 2003, San Francisco CA.
16. Organizing Committee, 14th PNWAVS 2003 Symposium, September 2003, Troutdale OR.

**External Peer Review: Journals, Grant Proposals, Conference Proceedings, and Textbooks**

***Promotion & Tenure Evaluator***

1. *Chemical and Biochemical Engineering, Missouri University of Science and Technology*
2. *Physics and Physical Science, Marshall University*
3. *Materials Science and Engineering, North Texas Tech University*
4. *College of Electrical Engineering and Computer Science, National Taiwan University*
5. *College of Electrical and Computer Engineering, National Chiao Tung University*
6. *College of Engineering, National Central University*
7. *Monash University, Malaysia*
8. *College of Engineering, West Virginia University*
9. *Washington State University*
10. *University of California, San Diego*

***Journal Article Review:***

1. ACS Applied Materials & Interfaces
2. ACS Applied Nano Materials
3. ACS Nano
4. Advanced Materials
5. Advanced Functional Materials
6. Applied Energy
7. Applied Physics Letters
8. Applied Physics A
9. Applied Physics D.
10. AIChE Journal



11. Applied Surface Science
12. Biotechnology Progress
13. Chemical Physics Letters
14. Chemistry of Materials
15. Chemical Engineering Journal
16. Chemical Engineering Education
17. CrystEngComm
18. Desalination
19. Electrochemical and Solid State Letters
20. European J Applied Physics
21. IEEE Transactions on Electron Devices
22. IEEE Transactions on Nanotechnology
23. IEEE Electron Device Letters
24. Industrial & Engineering Chemistry Research
25. International Journal of Thermal Sciences
26. International Journal of Hydrogen Energy
27. Journal of Alloys and Compounds
28. Journal of Electronic Materials
29. Journal of the American Chemical Society
30. Journal of Materials Chemistry and Physics
31. Journal of Materials Chemistry
32. Journal of Materials Chemistry C
33. Journal of Materials Chemistry A
34. Journal of Micro- and Nano- Manufacturing
35. Journal of Applied Physics
36. Journal of Crystal Growth
37. Journal of Display Technology
38. Journal of Phase Equilibria
39. Journal of Physics D: Applied Physics
40. The Journal of Physical Chemistry
41. Journal of the Electrochemical Society
42. Japanese Journal of Applied Physics
43. Journal of Biomolecular Structure and Dynamics
44. JVST B: Journal of Vacuum Science and Technology
45. Materials Science and Engineering B
46. Materials Science in Semiconductor Processing
47. Materials Research Bulletin
48. Materials Research Express
49. Molecular Simulation
50. MRS Communications
51. Nanoscale
52. Nanotechnology

53. Nature Communications
54. Nature Scientific Reports
55. Optics Letters
56. Recent Progress in Photovoltaics
57. Physica Status Solidi
58. PLOS One
59. Review of Scientific Instruments
60. RSC Advances
61. Science
62. Sensors
63. Small
64. Solid State Science
65. Scripta Materialia
66. Separation and Purification Technology
67. Surface Science
68. Thin Solid Films
69. Vacuum

***Competitive Proposal Review:***

1. Nazarbayev University Research Proposal Review
2. US DOE TCF
3. DOE NNSA MSIPP
4. US National Science Foundation (CBET, ECS, DMR, CMMI, IIP, STC, SEP, NRT I, II, SenSe)
5. National Research Foundation of Korea (NRF)
6. Sustainability Science Research Program, Academia Sinica Taiwan
7. Army Research Office
8. US Department of Energy Basic Energy Science
9. US DOE BTO
10. Hong Kong Innovation and Technology Fund
11. ACS Petroleum Research Fund
12. Louisiana State Board of Regents Support Fund R&D Program

***Conference Proceeding Review:***

1. Materials Research Society Symposium G Proceedings, MRS Fall 2008
2. The 4<sup>th</sup> Asia-Pacific Chemical Reaction Engineering Symposium Proceedings, 2005
3. Compound Semiconductor Photovoltaics, Materials Research Society Proceedings 763, 2003
4. Thin-Film Structures for Photovoltaics, Materials Research Society Proceedings 485, 1997

**5. Service to the Public**

**Outreach**

Mentor, Summer Experience in Science and Engineering for Youth, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2008, 2009, 2015, 2016, 2017, 2018, 2019 OSU  
Mentor, Apprenticeships in Science and Engineering Program, 2002, 2004, 2005, 2006, 2008, 2009, 2011, 2012. 2016 OSU

1. Ryan Nafziger – Albany High School OR 2016
2. Alvin Chang – Corvallis High School, Corvallis OR 2013, 2014  
“Growth and Characterizations of Copper Oxide Nanowires”
3. Derek Wong – Corvallis High School, Corvallis OR 2012  
“Photochemical Deposition of Copper Sulfide Thin Films”
4. Matthew Carlson – Corvallis High School, Corvallis OR 2009  
“Novel automatic dispensing system for thin film development”
5. David Ni – Crescent Valley High School, Corvallis OR 2008  
“The fabrication of a nanoporous electrode for a new type of Li-ion battery”
6. Mon-Ting “Megan” Lu – Corvallis High School, Corvallis OR 2006  
“Chemical bath deposition of nanostructured ZnO”
7. Genevieve Handloser – Philomath High School, Philomath, OR 2005  
“Fabrication of thin film electronics using soft solution deposition techniques”
8. Christopher Breeden – Marist High School, Eugene, OR 2004  
“Microcontact printing of surface monolayer for patterning of CBD CdS semiconductor layer”
9. Mary Fowler – Crescent Valley High School, Corvallis OR 2002  
“Plasma etching”
10. Danielle Villaret – Crescent Valley High School, Corvallis OR 2002  
“Copper electrodeposition”