

YOUNGHO SHIN

Applied Materials Division, Argonne National Laboratory,
9700 South Cass Avenue, Argonne, IL 60439, USA

yshin@anl.gov

EDUCATION

SEOUL NATIONAL UNIVERSITY, Seoul, Korea	2009.08
<i>Doctor of Philosophy, Chemical and Biological Engineering</i>	
<i>Advisor: Prof. Youn-Woo Lee</i>	
<i>Thesis: "In-situ Formation of Metal Oxides during Supercritical Water Oxidation of Acrylonitrile for TOC and TN Removal"</i>	
POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY, Pohang, Korea	1996.02
<i>Master of Science, Chemical Engineering</i>	
POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY, Pohang, Korea	1994.02
<i>Bachelor of Science, Chemical Engineering</i>	

HONORS & AWARDS

<i>U.S. DRIVE Highlight of Technical Accomplishments 2017</i> , USA	2017
<i>U.S. DRIVE Highlight of Technical Accomplishments 2013</i> , USA	2014
<i>President Obama's Visit to Cathode Scale-up Facility and Product Inspection</i> , USA	2013
<i>Chairman's Prize of Hanwha Chemical for LiFePO₄ Commercialization</i> , Korea	2011
<i>Green Technology Certificate of LiFePO₄ Plant</i> , Korean Government	2011
<i>Best Poster Award</i> , Supergreen 2009, Japan	2009
<i>Best Presentation Award</i> , ISASF 2008, Japan	2008
<i>Best Paper Award</i> , Energy for Environmental-Friendly 2007, Korean Government	2007
<i>Excellent Oral Presentation Award</i> , ISASF 2007, China	2007
<i>Best Poster Award</i> , Supergreen 2007, Korea	2007
<i>Oral Presentation Award</i> , ICSST 2007, China	2007
<i>Poster Award</i> , ISSF 2006, Japan	2006
<i>Korean Student Representative</i> for 111 th International Summer Course of BASF, Germany	2006
<i>Innovation Award for Research Quality</i> , Hanwha Chemical, Korea	2003
<i>Chairman's Prize of Hanwha Chemical for SCWO Commercialization</i> , Korea	1999
<i>New Technology Certificate of SCWO Technology</i> , Korean Government	1999
<i>Honor Student Award</i> , Pohang University of Science and Technology, Korea	1992

PROFESSIONAL EXPERIENCES

- Energy Systems Division, Argonne National Laboratory, IL, USA
Principal Process Development Engineer 2011.05 – Present
 - Active battery material group leader at ANL MERF

- Lead the transfer of new materials to pilot and mass production scale
 - Conduct bench and pilot scale material composition, synthesis and performance optimization to make them suitable for high volume production.
 - Evaluation of emerging manufacturing technologies for advanced material
 - Development of a customized synthesis process for target material
 - Surface modification of battery materials for better performance and cyclability
 - Particle morphology engineering of battery material to impart functionality
 - Material composition and synthesis process optimization
 - Expert knowledge and extensive practical experience in chemical reaction and process equipment, including co-precipitation, calcination, milling, and surface coating
- Hanwha Chemical R&D Center, Daejeon, Korea
- Principal Research Engineer** 2010.02 – 2011.04
- Commercialization project leader of process development & commercialization division
 - Design, start-up and normalization for LiFePO₄ commercial plant (1000 tons/year)
 - Process development for LiFePO₄ synthesis using supercritical hydrothermal method
 - Bench-scale and pilot-scale production of cathodes (LCO, LTO, LFP, LMP, LFMP and LNMO)
 - Basic design and construction of continuous hydrothermal bench equipment and pilot plant.
- Senior Research Engineer** 1995.12 – 2006.02
- Project leader of process development & commercialization division
 - Commercialization of continuous TPA hydrothermal process
 - Commercialization of continuous DNT supercritical hydrothermal process
 - Commercialization of continuous Melamine hydrothermal process
 - Pilot construction for supercritical hydrothermal synthesis of CeO₂ nanoparticle
 - Pilot construction for supercritical methanol esterification of palm oil for bio-diesel production
 - Design and construction of batch and continuous hydrothermal systems
 - Supercritical carbon dioxide extraction of Taxol on a pilot scale
 - Hydro/solvothermal synthesis of nanoparticles
 - Supercritical water decomposition of endocrine disruptors
 - Supercritical water decomposition of chemical weapons
 - Development of thermochemical treatment process of ion exchange resin of nuclear power plant
- SEOUL NATIONAL UNIVERSITY, Seoul, Korea
- Post-doctoral Research Associate** 2009.09 – 2010.01
- Process development for the mass production of lithium iron phosphate (LiFePO₄)
 - In-depth research on the synthesis processes of LiCoO₂ and Li₄Ti₅O₁₂
 - Investigation for the in-situ formation of metal oxides with the partial oxidation of organics
- Korean Institute of Chemical Engineers, Seoul, Korea
- Lecturer**, Curriculum for human resources of industry, the Korean Government 2006.11 – 2008.01
- Lecture for high-pressure and high-temperature systems
 - Training management for actual lab experiments
- SEOUL NATIONAL UNIVERSITY, Seoul, Korea
- Teaching Assistant**, School of Chemical and Biological Engineering 2006.03 – 2006.12
- Lecture and advice for undergraduate students for Fluid Mechanics and Separation Process
- SEOUL NATIONAL UNIVERSITY, Seoul, Korea
- Lab Manager**, Supercritical Fluid Process Laboratory 2006.03 – 2006.12
- Establishment of safe operation procedure for high-pressure and high-temperature system
 - Set-up of 4 bench-scale equipment and 5 analytical apparatuses

ACTIVITIES

- *Member of MRS (Material Research Society)* 2014.01
- *Member of ECS (The Electrochemical Society)* 2014.01
- *Examiner of 2010 Campus Patent Strategy Universiade (cathode material division)* 2010.10
- *EMP-IRPE (International Register of Professional Engineers)* 2009.12
- *APEC (Asia-Pacific Economic Cooperation) Engineer* 2009.12
- *Professional Engineer (Chemical Engineering)* 2005.09

EXPERTISE

- **Material synthesis, composition optimization, morphology engineering of nano- or micron-sized particles**
 - Solvothermal synthesis and scale-up of silicon and silicon-containing nanoparticles
 - Core-shell, Core-gradient, Tangent-gradient, Digital-gradient Ni-rich NMC battery materials
 - Surface modification of NMC811 to enable fast charge/discharge battery application
 - Particle structure engineering of cobalt-free high energy battery material
 - Scale-up of Ni-rich, layered-layered, and layered-layered-spinel battery materials
 - Aluminum fluoride surface coating on high-energy LMR-NMC battery material
 - Continuous supercritical hydrothermal synthesis of LiFePO₄ battery material
 - Continuous supercritical hydrothermal synthesis of HT-LiCoO₂ battery material
 - Continuous synthesis of surface-modified zinc oxide nanoparticles in supercritical methanol
 - Continuous synthesis of surface-modified ceria oxide nanoparticles in supercritical methanol
 - Synthesis of cobalt nanoparticles in supercritical methanol
 - Synthesis process R&D of terephthalic acid from p-xylene using supercritical carbon dioxide
 - Simultaneous synthesis of biodiesel and zinc oxide nanoparticles using supercritical methanol
 - Simultaneous carbon capture and nitrogen removal during supercritical water oxidation
 - Vegetable oil aided hydrothermal synthesis of cerium oxide nanocrystals
 - Supercritical carbon dioxide extraction of acrylic acid from super-absorbent polymer
- **Process development and optimization with scalability and economic feasibility**
 - Reactor design and P&ID drawing for bench-scale and pilot-scale processes
 - Evaluation of emerging manufacturing technologies for material synthesis
 - Systematic process scale-up research using 1L, 10L, and 40L Tayler vortex reactors
 - Experiment design, operation, process analysis and modification under development
 - Develop hydrothermal synthesis process of LiFePO₄ battery material
 - Develop a surface coating process for fast charge/discharge battery application
 - Develop an advanced CSTR to control the particle size, distribution, and morphology
 - Supercritical carbon dioxide extraction process for Paclitaxel
 - Extensive experience of material preparation using batch, CSTR, and Tayler vortex reactor
 - Extensive experience on calcination process such as box furnace, RHK and rotary kiln
 - Design of Experiment to enhance material quality and process reproducibility
 - Establish standard procedures for material synthesis and process operation
- **Process scale-up, commercialization, and mass production**
 - Project leading of the world's first supercritical hydrothermal plant of LiFePO₄ battery material
 - Start-up, problem-shooting, normalization, and optimization of commercial plant
 - Extensive experience of hydro/solvothermal synthesis process from bench to commercial plant
 - Process optimization of spray dryer from pilot to commercial-scale
 - Process optimization of RHK and rotary kiln from pilot to commercial-scale

- Commercialization of continuous TPA (terephthalic acid) hydrothermal process
- Commercialization of continuous DNT (dinitrotoluene) supercritical hydrothermal process
- Commercialization of continuous Melamine hydrothermal process

PUBLICATIONS

16. M. M. Thackeray, J. R. Croy, Eungje Lee, A. Gutierrez, Meinan He, Joong Sun Park, B. T. Yonemoto, B. R. Long, J. D. Blauwkamp, C. S. Johnson, **Y.H. Shin** and W. I. F. David “The quest for manganese-rich electrodes for lithium batteries: strategic design and electrochemical behavior, *Sustainable Energy Fuels*, 2, 1375–1397 (2018)
15. J. R. Croy, J. S. Park, **Y.H. Shin**, B. T. Yonemoto, M. Balasubramanian, B. R. Long, Y. Ren and M. M. Thackeray, “Prospects for spinel-stabilized, high-capacity lithium-ion battery cathodes”, *Journal of Power Sources* 334, 213 (2016)
14. **Y.H. Shin**, O. Kahvecioglu Feridun, G.K. Krumdick, “Scale-up of High Energy Cathode Materials for Electric Vehicles at Argonne's Materials Engineering Research Facility”, *Materials Matters* (2014)
13. D.S. Kim, **Y.H. Shin** and Y.-W. Lee “Synthesis of terephthalic acid by catalytic partial oxidation of p-xylene in supercritical carbon dioxide”, *Chemical Engineering Communications*, 202, 78 (2014)
12. M. Kim, H.-s. Lee, S.J. Yoo, Y.-S. Youn, **Y.H. Shin**, Y.-W. Lee, “Simultaneous synthesis of biodiesel and zinc oxide nanoparticles using supercritical methanol”, *Fuel*, 109, 279 (2013)
11. **Y.H. Shin**, H.-s. Lee, B. Veriansyah, J. Kim, D.S. Kim, H.W. Lee, Y.-S. Youn, Y.-W. Lee, “Simultaneous carbon capture and nitrogen removal during supercritical water oxidation”, *J. Supercrit. Fluids* 72, 120 (2012)
10. M. Kim, H.-s. Lee, **Y.H. Shin**, K.H. Ahn, Y.-S. Youn, J. Kim and Y.-W. Lee, “Vegetable oil aided hydrothermal synthesis of cerium oxide nanocrystals”, *Korean J. Chem. Eng.*, 29, 1289 (2012)
9. N.C. Shin, Y.-H. Lee, **Y.H. Shin**, J. Kim and Y.-W. Lee “Synthesis of cobalt nanoparticles in supercritical methanol”, *Materials Chemistry and Physics* 124, 140 (2010)
8. B. Veriansyah, J.-D. Kim, B.K. Min, **Y.H. Shin**, Y.-W. Lee and J. Kim, “Continuous synthesis of surface-modified zinc oxide nanoparticles in supercritical methanol”, *J. Supercrit. Fluids* 52, 76 (2010)
7. **Y.H. Shin**, S.-M. Koo, D.S. Kim, Y.-H. Lee, B. Veriansyah, J. Kim and Y.-W. Lee, “Continuous hydrothermal synthesis of HT-LiCoO₂ in supercritical water”, *J. Supercrit. Fluids* 50, 250 (2009)
6. B. Veriansyah, H. Park, J.-D. Kim, B.K. Min, **Y.H. Shin**, Y.-W. Lee and J. Kim, “Characterization of surface-modified ceria oxide nanoparticles synthesized continuously in supercritical methanol”, *J. Supercrit. Fluids* 50, 283 (2009)
5. **Y.H. Shin**, H.-s. Lee, Y.-H. Lee, J. Kim, J.-D. Kim and Y.-W. Lee, “Synergetic effect of copper-plating wastewater as a catalyst for the destruction of acrylonitrile wastewater in supercritical water oxidation”, *J. Hazard. Mater.* 167, 824 (2009)

4. **Y.H. Shin**, N.C. Shin, B. Veriansyah, J. Kim and Y.-W. Lee, "Supercritical water oxidation of wastewater from acrylonitrile manufacturing plant", *J. Hazard. Mater.* 163, 1142 (2009)
3. H.-s. Lee, J.-h. Choi, **Y.H. Shin**, Y. Lim, C. Han, H. Kim and Y.-W. Lee, "Effect of additives on the contents of fatty acid methyl esters of biodiesel fuel in the transesterification of palm oil with supercritical methanol", *Korean Chem. Eng. Res.*, 46, 747 (2008)
2. J.H. Han, K.D. Han, C.M. Chung, S.H. Do and **Y.H. Shin**, "Optimization of TDA Recycling Process for TDI Residue using Near-critical Hydrolysis Process", *Korean Chem. Eng. Res.*, 44, 650 (2006)
1. J.H. Han, C.M. Chung, S.H. Do, K.D. Han and **Y.H. Shin**, "Optimization of Supercritical Water Oxidation (SCWO) Process for Decomposing Nitromethane", *Korean Chem. Eng. Res.*, 44, 659 (2006)

PATENTS

16. **Y.H. Shin** and Gregory K. Krumdick, "Tangent gradient concentration material for battery, digital gradient concentration material for battery", US Patent filed (2018)
15. **Y.H. Shin**, Ozgenur K. Feridun and Gregory K. Krumdick, "Pressurized Taylor vortex reactor", US Patent filed (2018)
14. H. Dai, A. K. Padhi, H. Wu, D. Wang, C. S. Johnson, J. D. Carter, M. Bettge, A. Kircova, C. Lin, **Y.H. Shin**, X. Wang, "Cathode active materials for lithium-ion batteries", US Patent No: 20170263917 issued (2017)
13. **Y.H. Shin**, G. Krumdick and K. Takeya, "Method for producing size selected particles", US Patent 9446967 issued (2016)
12. K.H. Song, K.D. Han and **Y.H. Shin**, "Method for calcining electrode materials using a rotary kiln", KR1193422 (2012, issued), WO2012124990 (2012, issued), CA2827930 (2012, issued), TW201244233 (2012, issued), CN103430356 (2013, issued), US20140004473 (2014, issued), EP2688125 (2014, issued), JP2014507776 (2014, issued)
11. Y.-W. Lee, B. H. Kang, **Y.H. Shin** and H. Kim, "Method of eliminated acrylic acid and moisture from super-absorbent polymer", KR100994217 (2010, issued)
10. Y.-W. Lee, **Y.H. Shin**, H. Kim and B.H. Kang, "Method of treatment of organic wastewater mixed with inorganic wastewater and apparatus for treatment of organic wastewater mixed with inorganic wastewater", KR20100006008 (2010, issued)
9. J.H. Han, **Y.H. Shin**, S.H. Do, K.D. Han, C.M. Chung and H.J. Kim, "Method for treating wastes from terephthalic acid process", KR0662146 (2006, issued), WO2007029956 (2007, issued), CN101257975 (2008, issued), JP4763789 (2011, issued)
8. C.M. Chung, S.H. Do, J.H. Han, K.D. Han, **Y.H. Shin** and G.W. Han, "Method and process for decomposition of aliphatic nitrile compound", KR1020070027031 (2007, issued)
7. **Y.H. Shin**, S.H. Do, J.H. Han, K.D. Han, C.M. Chung and G.W. Han, "Supercritical water oxidation process for wastewater containing organic components", KR1020060022743 (2006, issued)

6. K.D. Han, J.H. Han, C.M. Chung, **Y.H. Shin**, S.H. Do and G.W. Han, "Method for recovering toluene diamine from high boiling tar residue discharged from toluene diisocyanate preparation process", WO2004108656 (2004, issued), CN1802344 (2006, issued), DE112004001020 (2006, issued), KR100578607 (2006, issued)
5. K.D. Han, J.H. Han, C.M. Chung, **Y.H. Shin**, S.H. Do and G.W. Han, "Method for recovering toluene diamine from solid wastes of toluene diisocyanate plant", KR1020040105883 (2004, issued)
4. J.H. Han, M.J. Rho, Y.J. Choi, **Y.H. Shin**, C.M. Chung and G.W. Han, "Process for treating waste water containing a nitrous organic components", WO2002081379 (2002, issued), KR100398799 (2003, issued), CN1501889 (2004, issued), CN1261363 (2006, issued)
3. H.Y. Won, J.S. Gong, J.H. Lee, S.W. Gong, **Y.H. Shin**, J.H. Lee and K.H. Choi, "Composition and manufacturing method of fluorescent material for polymer", Korean Patent (2000, filed)
2. J.H. Han, M.J. Rho, **Y.H. Shin**, G.H. Choi, S.H. Han, Y.S. Kim and Y.C. Kim, "Process of supercritical water oxidation for wastewater containing organic compounds", Korean Patent (1999, filed)
1. J.H. Han, M.J. Rho, **Y.H. Shin**, G.H. Choi, S.H. Han and Y.S. Kim, "Process of supercritical water oxidation and catalytic oxidation for wastewater containing organic Compounds", Korean Patent (1999, filed)