

# Sungwoo Yang

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**Assistant Professor**  
**Civil and Chemical Engineering**  
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## EDUCATION

**Duke University** Durham, NC  
Advisor: Jie Liu

**Illinois Institute of Technology** Cambridge, MA

## EMPLOYMENT

**Massachusetts Institute of Technology** (Cambridge, MA) 2016 –Present  
Research scientist

**Massachusetts Institute of Technology** (Cambridge, MA) 2012 –2015  
Postdoctoral Associate, Advisor: Evelyn N. Wang

**Duke University** (Durham, NC) 2006 – 2011  
Research Assistant

## PAPERS IN REFEREED JOURNALS

### Published and In Press

- 1) A Rieth, **S. Yang**, E Wang, M Dinca, Record Atmospheric Fresh Water Capture and Heat Transfer with a Material Operating at the Water Uptake Reversibility Limit, ACS Cent. Sci., 3 (6), pp 668–672 (2017)
- 2) E Strobach, B Bhatia, **S. Yang**, L Zhao, EN Wang, High temperature annealing for structural optimization of silica aerogels in solar thermal applications, Journal of Non-Crystalline Solids 462, 72-77 (2017)
- 3) H. Kim, **S. Yang**, S. Narayanan, H. Furukawa, J. Jiang, A. Umans, O. Yaghi and E. Wang, Harvesting Water from Humid Air using Metal-Organic Frameworks, <https://doi.org/10.1126/science.aam8743>, **Science** (2017)
- 4) E. Strobach, B. Bhatia, **S. Yang**, L. Zhao, and E. N. Wang, High Temperature Annealing for Structural Optimization of Silica Aerogels in Solar Thermal Applications, 2017 (J. Non-Cryst. Solids, In press)
- 5) S. Narayanan, H. Kim, A. Umans, **S. Yang**, X. Li, S. Schiffres, S. Rao, C. Rios, C. Hidrovo, and E. Wang, A Thermophysical Battery for Storage-based Climate Control, Applied Energy, 189, 1, 31–43 (2017)
- 6) **S. Yang**, X Huang, G Chen, EN Wang, Three-Dimensional Graphene Enhanced Heat Conduction of Porous Crystals, Journal of Porous Materials (In press), <http://link.springer.com/article/10.1007>
- 7) L. Zhao, **S. Yang**, B. Bhatia, E. Strobach and E. Wang, Modeling silica aerogel optical performance by determining its radiative properties, AIP Advances 6, 025123 (2016)
- 8) H. Kim, H. J. Cho, S. Narayanan, **S. Yang**, S. Schiffres, X. Li, H. Furukawa, Y. Zhang, J. Jiang, O. M. Yaghi and E. N. Wang, Characterization of Adsorption Enthalpy of Novel Water-Stable Zeolites and Metal-Organic-Frameworks, Scientific Reports, 2016, 6, 19097
- 9) **S. Yang**, H. Kim, S. Narayanan, I. McKay and E. Wang, Carbon Nanomaterials as Binders for Advanced Thermal Batteries, Materials & Design 2015, 85, 520

- 10) S. Narayanan, X. Li, **S. Yang**, H. Kim, A. Umans, I.S. McKay, E.N. Wang, Thermal battery for portable climate control, *Applied Energy*, 149, p. 104-116, 2015.
- 11) S. Chae, D. Hunt, K. Ikuma, **S. Yang**, J. Cho, C. Gunsch, J. Liu and M. Wiesner, Aging of fullerene C60 nanoparticle suspensions in the presence of microbes, *Water Research*, 2014, 65, 282-289
- 12) S. Narayanan, **S. Yang**, H. Kim, and E. Wang, Optimization of Adsorption Processes for Climate Control and Thermal Energy Storage, *Journal of heat transfer*, 2014, 77, 288–300.
- 13) J. Cho, N. Salleh, C. Blanco, **S. Yang**, C. Lee, Y. Kim, J. Kim and J. Liu, Novel synthetic methodology for controlling the orientation of zinc oxide nanowires grown on silicon oxide substrates. *Nanoscale*, 2014, 6, 3861-3867.
- 14) **S. Yang**, Y. Cai, Y. Cheng, C. V Varanasi and J. Liu Monolithic co-Aerogels of Carbon/Titanium Dioxide as Three Di-mensional Nanostructured Electrodes for Energy Storage. *Journal of Power Sources*, 218, 15, 2012, pp 140–147.
- 15) J. Cho, Q. Lin, **S. Yang**, J. Simmons, Y. Cheng, E. Lin, J. Yang, J. Foreman, H. Everitt, W. Yang and J. Liu, Sulfur-doped zinc oxide (ZnO) Nanostars: Synthesis and simulation of growth mechanism, *Nano Research* 2012, 5, 1, 20-26.
- 16) **S. Yang**, A. Parks, S. Saba, P. Lee Ferguson and J. Liu, Photoluminescence from Inner walls in Double-Walled Carbon Nanotubes: Some Do, Some Do Not. *Nano Letters*, 2011, 11(10), 4405-4410.
- 17) W. Zhou, L. Ding, **S. Yang** and J. Liu Synthesis of High-Density, Large-Diameter, and Aligned Single-Walled Carbon Nanotubes by Multiple-Cycle Growth Methods. *ACS Nano*, 2011, 5 (5), 3849–3857.
- 18) W. Zhou, L. Ding, **S. Yang** and J. Liu Orthogonal Orientation Control of Carbon Nanotube Growth. *J. Am. Chem. Soc.*, 2010, 132 (1), 336–341.
- 19) Y. Feng, H. Zhang, H. Ye, T. McNicholas, D. Yuan, **S. Yang**, W. Feng and J. Liu Room Temperature Purification of Few-Walled Carbon Nanotubes with High Yield. *ACS Nano*, 2008, 2 (8), 1634–1638.

#### PAPERS AND PRESENTATIONS IN REFEREED CONFERENCE PROCEEDINGS

- 1) H. Kim, **S. Yang**, S. Narayanan, I. Mckay, and E. Wang, "Experimental Characterization of Adsorption and Transport Properties for Advanced Thermo-Adsorptive Batteries" ASME 2013 International Mechanical Engineering Congress and Exposition, IMECE2013-65490
- 2) S. Narayanan, X. Li, **S. Yang**, I. Mckay, H. Kim and E. Wang, "DESIGN AND OPTIMIZATION OF HIGH PERFORMANCE ADSORPTION-BASED THERMAL BATTERY" Proceedings of the ASME 2013 Heat Transfer Summer Conference, HT2013-17472
- 3) **S. Yang** and J. Liu, "Sorting Carbon Nanotubes by Number of Sidewalls" MRS proceedings, 2008, 1142,1142-JJ10-06.

#### TALKS AND SEMINARS

- 1) **S. Yang**, L. Zhao, B. Bhatia, E. Strobach, L. Weinstein, T. Cooper, S. V. Boriskina, G. Chen, E. N. Wang, "Transparent Aerogels for Efficient Solar-Thermal Energy Conversion" MRS Spring Meeting, Phoenix, AZ, March 28-April 1, 2016.
- 2) **S. Yang**, L. Weinstein, T. Cooper, L. Zhao, B. Bhatia, E. Strobach, S. V. Boriskina, G. Chen, E. N. Wang, "Transparent Aerogels for Efficient Solar-Thermal Energy Conversion" ARPA-e Program Review, Mesa, AZ, March 29-April 1, 2016.
- 3) E. Strobach, **S. Yang**, L. Zhao, B. Bhatia, L. Weinstein, T. Cooper, S. V. Boriskina, G. Chen, E. N. Wang, "Solar Thermal Aerogel Receiver (STAR)", MIT Energy Night, Cambridge, MA, October 16, 2015.
- 4) **S. Yang**, H. Kim, S. Narayanan, I. McKay, E.N. Wang, "Carbon Nanomaterials as Binders for Advanced Thermal Batteries", MRS Spring Meeting, San Francisco, CA, April 1-5, 2013.
- 5) **S. Yang**, J. Liu, E.N. Wang, "Three Dimensional Carbon/Manganese Oxide co-Aerogels as Anodes for High Energy Density Microbatteries," MRS Spring Meeting, San Francisco, CA, April 1-5, 2013.

- 6) **S. Yang**, S. Narayanan, X. Li, I. McKay, H. Kim, E.N. Wang, "Graphenes with Metal Organic Frameworks and/or Zeolites for Advanced Thermal Batteries," ICAE, Jeju, South Korea, November 12-15, 2013. (Invited talk)
- 7) **S. Yang**, H. Kim, S. Narayanan, E.N. Wang, "Graphenes and Metal Organic Frameworks/Zeolites for Advanced Thermal Batteries," MRS, Boston, USA, December 1-6, 2013.
- 8) 2011 MRS fall - Hybrid Carbon/ Titanium Dioxide Aerogels as Active Materials for Lithium Ion Batteries
- 9) 2010 MRS fall - Dye Sensitized Solar Cells Using Uniform TiO<sub>2</sub>/CNT gel
- 10) 2009 MRS fall - Carbon Nanotube-silicon Heterojunction Solar Cells with Controlled Electronic Properties
- 11) 2008 MRS fall - Sorting Carbon Nanotubes by Number of Sidewalls

#### **PATENTS (GRANTED AND APPLICATIONS)**

- 1) Evelyn Wang, Shankar Narayanan, **Sungwoo Yang**, Hyunho Kim and Ari Umans , "Harvesting Water from Humid Air Using Adsorbents/Absorbents and Low Grade Energy", M.I.T. Case No. 18983
- 2) Gang Chen, Evelyn N. Wang, Svetlana V. Boriskina, Lee A. Weinstein, **Sungwoo Yang**, Bikram Bhatia, Lin Zhao, Elise M. Strobach, Thomas A. Cooper, David M. Bierman, Xiaopeng Huang, James Loomis, SOLAR THERMAL AEROGEL RECEIVER (STAR), Application number: 62/299090, US, 2016/2/14
- 3) Ian S. McKay, **Sungwoo Yang**, Evelyn N. Wang, Hyunho Kim, Percolated Microstructures for Multi-Modal Transport Enhancement in Porous Active Materials, Patent number: US20150132565A1, Application number: US14540164, US, 2015/5/14.
- 4) Gang Chen, Evelyn N. Wang, Svetlana V. Boriskina, Kenneth McEnaney, Hadi Ghasemi, Selcuk Yerci, Andrej Lenert, **Sungwoo Yang**, Nenad Miljkovic, Lee A. Weinstein, David Bierman, Internally-Heated Thermal and Externally-Cool Photovoltaic Cascade Solar Energy System for Full Solar Spectrum Utilization, Patent number: US20150053266A1, Application number: US14464103, US, 2015/2/26.
- 5) H. Kim, **S. Yang**, S. Rao and E. Wang, Water Harvesting Using Metal Organic Frameworks, U.S. Application No.: 62/436543, 2016

#### **PROPOSAL EXPERIENCES**

- 1) ARPA-E (Award), Program: HEATS, Controlled number: 0471-1627, Advanced Thermo-Adsorptive Battery Climate Control System (ATB), Project Term: 12/13/2011 to 09/13/2016
- 2) ARPA-E (Award), Program: FOCUS, Controlled number: DE-AR0000471, Full-Spectrum Stacked Solar-Thermal and PV Receiver, Project Term: 06/17/2014 to 06/16/2017
- 3) ARPA-E (Non-Award), Program: SHIELD, Controlled number: DE-FOA-0001425, SEALED HIGHLY-INSULATING AEROGEL-PANES FOR DURABLE & EFFICIENT (SHADE) WINDOW RETROFITS
- 4) Buildings Energy Efficiency Frontiers & Innovation Technologies (BENEFIT) of DOE, Announce number: DE-FOA-0001632, Cascaded Double-Effect Adsorption System with Tailored Metal-Organic Frameworks (in review)
- 5) J-WAFS Request for Water & Food Related Proposals, Abdul Latif Jameel World Water and Food Security Lab, Clean water harvesting technology using MOFs (in review)

#### **AWARDS**

Invited speaker at ICAE conference	2012
Duke Nanoscience Program (GPNANO) fellowship	2006
Korea Research Foundation Scholarship	2005 – 2006
Dean's List of Illinois Institute of Technologies	2005 - 2006
Society of Cosmetic Chemists scholarship	2005
International scholarship	2004 –2005

## **TEACHING and MENTORING EXPERIENCE**

### **MIT Teaching Certificate (2014)**

#### Classroom Experience

- 1) Teaching assistance (2006 ~ 2007)

#### Mentoring Experience

- 1) Lin Zhao (MIT) through STAR project since 2014 Summer
- 2) Hyunho Kim (MIT) through ARPA-e project since 2012 Summer
- 3) Stacy Saba (Cornell University) through CEINT summer Research Internship Program during 2011 Summer
- 4) Osagie Obanor (Duke University) through Duke Summer Research Internship Program during 2010 Summer
- 5) Trenton M. Alford (Laurinburg high school) through Project SEED 2009 summer

## **REVIEWER EXPERIENCES**

- Nature Communications
- Advanced Materials
- Advanced Materials Interfaces
- Carbon
- ACS Applied Materials & Interfaces
- ACS Applied Materials & Interfaces

## **MEDIA COVERAGE**

“FOCUS TECHNOLOGY SNAPSHOT - MIT'S STACKED HYBRID SOLAR CONVERTER”

<http://arpa-e.energy.gov/?q=technology-snapshots/focus-technology-snapshot-mits-stacked-hybrid-solar-converter>

“Adsorption-based thermal batteries could help boost EV range by 40%”, SAE International, 2013

<http://articles.sae.org/12376/>

“Double-walled nanotubes shine, sometimes” by Ashley Yeager, Duke Research lab blog, 2011.

<https://sites.duke.edu/dukeresearch/2012/01/13/double-walled-nanotubes-shine-sometimes/>