SIDY NDAO

Associate Professor
Director of the Nano & Microsystems Research Lab
Dept. of Mechanical and Materials Engineering
University of Nebraska-Lincoln

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Education

Massachusetts Institute of Technology (MIT) — Cambridge, MA
Postdoctoral Associate — 2011 - 2012
Dept. of Chemical Engineering, MIT Institute for Soldier Nanotechnology

Rensselaer Polytechnic Institute — Troy, NY
Ph.D., Mechanical Engineering — December 2010

The City College of New York — New York City, NY
M.E., Mechanical Engineering — August 2007

The City College of New York — New York City, NY
B.E., Mechanical Engineering — May 2005

Professional Appointments & Activities

Associate Professor in the Dept. of Mechanical and Materials Engineering, University of Nebraska-Lincoln (Research Lab: http://nmrl.unl.edu) — **2018 – Present**

Assistant Professor in the Dept. of Mechanical and Materials Engineering, University of Nebraska-Lincoln — **2012 – 2018**

Founder of SenEcole – Capacity Building for an Emerging Africa (http://senecole.com) — **2008 – Present**

Founder of the Pan-African Robotics Competition (http://parcrobotics.org) — **2015 – Present**

Founder of the Dakar American University of Science & Technology (http://daust.org) — **2016 – Present**

Executive Committee (http://nanoscale.unl.edu/), Nebraska Nanoscale Facility (NNF) — **2015 – Present**

Publications & Invited Talks

INVITED TALKS

1. **Invited Panelist**, "Changing the Way We Learn: Building Scientific Culture Early On" NEF Global Gathering, Kigali, Rwanda, March 26-28, 2018

2. **Keynote Speaker**, "High Temperature NanoThermoMechanical Computing" 3rd Thermal and Fluids Engineering Conference in Ft. Lauderdale, March 4-7, 2018

3. **Invited Panelist**, "State of the Africa Region: Skills for Success in a Transforming Africa," World Bank–IMF Annual and Spring Meetings, Washington DC, October 14, 2017

4. "Can Africa Rise without Research-based Innovation?" African Institute of Mathematical Sciences, Kigali, Rwanda, September 2017

5. "Controlling Heat Flow at the Micro & Nanoscale: Application in Thermal Management and Thermal Computing," King Abdullah University of Science and Technology, Saudi Arabia, April 2017

6. "Near-Field Thermal Radiation for Solar Thermophotovoltaics and High Temperature Thermal Logic and Memory Applications," NEBRASKA MRSEC Symposium, March 2017

7. "Two-Phase Heat Transfer from Self-Assembled Multiscale Metallic Surfaces," NASA Glenn Research Center, Cleveland, Ohio, November 2014

8. **Keynote Speaker**, "State-of-the-Art of Functionalized Micro/Nano Engineered Two-phase Heat Transfer Surfaces," 12th International Conference on Nanochannels, microchannels, and Minichannels, Chicago, Illinois, August 2014

9. "Nano/Microsystems: Energy and Biomedical Applications", Regenerative Medicine, University of Nebraska Medical Center (UNMC), Omaha, NE, February 2013.

JOURNAL PUBLICATIONS

1. Hamed, A., Elzouka, M., Ndao, S., "Thermal Calculator," International Journal of Heat and Mass Transfer, Under Review, 2018

2. Hamed, A., **Ndao, S.**, "High Anisotropy Metamaterial Heat Spreader," *International Journal of Heat and Mass Transfer*, In Press, 2018

3. Elzouka, M., **Ndao, S.**, "Meshed Doped Silicon Photonic Crystals for Manipulating Near-Field Thermal Radiation," *Journal of Quantitative Spectroscopy & Radiative Transfer*, 204, 56-62, 2018

4. Elzouka, M., **Ndao, S.**, "High Temperature Near-Field NanoThermoMechanical Rectification," *Nature Scientific Reports*, 7, 44901, 2017

5. Davis, E., Liu, Y., Jiang, L., Lu, Y., **Ndao, S.**, "Wetting Characteristics of 3-Dimensional Nanostructured Fractal Surfaces," *Applied Surface Science*, 392, 929–935, 2017

6. Davis, E., **Ndao, S.**, "On the Wetting States of Low Melting Point Metal Galinstan® on Silicon Microsctructured Surfaces," *Advanced Engineering Materials*, In Press, 2017

7. Kruse, C., Lucis, M., Shield, J., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Effects of Femtosecond Laser Surface Processed Self-Organized Nanoparticles on Pool Boiling Heat Transfer Performance," *Applied Thermal Engineering*, In Press, 2017

8. Kruse,C., Tsubaki, A., Zuhlke, C., Anderson, T., Alexander, D., Gogos, G., **Ndao, S.**, "Secondary Pool Boiling Effects," *Applied Physics Letters*, 108(5), 051602, 2016

9. Hassebrook, A., Kruse, C., Wilson, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Effects of Droplet Diameter and Fluid Properties on the Leidenfrost Temperature of Polished and Micro/Nanostructured Surfaces," *Journal of Heat Transfer*, 138(5), 051501, 2016

10. Ems, H., **Ndao, S.**, "Microstructure-alone induced transition from hydrophilic to hydrophobic wetting state on Silicon," *Applied Surface Science*, 339, pp. 137–143, 2015

11. Kruse, C., Somanas, I., Anderson, T., Wilson, C., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Self-Propelled Droplets on Heated Surfaces with Angled Self-Assembled Micro/Nanostructures," *Microfluidics and Nanofluidics*, 18 (5), pp 1417-1424, 2015

12. Elzouka, M., **Ndao, S.**, "Towards A Near-Field Concentrated Solar Thermophotovoltaic Microsystem: Part I - Modeling," *Solar Energy*, 2015

13. Kruse, C., Wilson, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Enhanced Pool-Boiling Heat Transfer and Critical Heat Flux on Femtosecond Laser Processed Stainless Steel Surfaces," *International Journal of Heat and Mass Transfer*, 82, pp. 109–116, 2015

14. Elzouka, M., **Ndao, S.**, "Near-Field NanoThermoMechanical Memory," *Applied Physics Letters*, 105, 243510, 2014

15. **Ndao, S.**, Peles, Y., and Jensen, M. K., "Micro device design and fabrication for the experimental investigation of jet impingement on an array of micro pin fins," *Journal of Micromechanics and Microengineering*, 24 105005, 2014

16. **Ndao, S.**, Peles, Y., and Jensen, M. K., "Effects of pin fin shape and configuration on the single-phase heat transfer characteristics of jet impingement on micro pin fins," *International Journal of Heat and Mass Transfer*, 70, pp. 856-863, 2014

17. Kruse, C., Anderson, T., Wilson, C., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Extraordinary Shifts of the Leidenfrost Temperature from Multiscale Micro/Nanostructured Surfaces," *Langmuir*, 29 (31), pp 9798–9806, 2013

18. **Ndao, S.**, Jensen, K. F., Velmahos, G., King, D. R., "Design and demonstration of a battery-less fluid warmer for combat", *Journal of Special Operations Medicine*, 13 (3), pp. 31-5, 2013

19. Rinnerbauer, V. **Ndao, S.**, Yeng, Y. X., Bermel, P., Senkevich, J., Jensen K. F., Joannopoulos, J. D., Soljačić, M., and Celanovic, I., "Large-area fabrication of high aspect ratio tantalum photonic crystals for high-temperature selective emitters," *Journal of Vacuum Science & Technology B*, 31, 011802, 2013

20. Rinnerbauer, V., **Ndao, S.**, Yeng, Y. X., Bermel, P., Senkevich, J., Celanovic, I., and Soljačić, M., "Recent developments in high-temperature photonic crystals," *Energy Environmental Science*, 5 (10), pp. 8815 – 8823, 2012

21. **Ndao, S.**, Peles, Y., and Jensen, M. K., "Experimental investigation of flow boiling heat transfer of jet impingement on smooth and micro structured surfaces," *International Journal of Heat and Mass Transfer*, 55(19-20), pp. 5093–5101, 2012

22. **Ndao, S.**, Lee, H. J., Peles, Y., and Jensen, M. K., "Heat transfer enhancement from micro pin fins subjected to an impinging jet," *International Journal of Heat and Mass Transfer*, 55(1-3), pp. 413-421, 2012

23. Basu S., **Ndao S.**, Michna G. J., Peles Y., and Jensen M. K., "Flow boiling of R134a in circular microtubes. Part II: study of critical heat flux condition," *Journal of Heat Transfer*, 133(5), 051503, 2011

24. Basu S., **Ndao S.**, Michna G.J., Peles Y., and Jensen M. K., "Flow boiling of R134a in circular microtubes. Part I: study of heat transfer characteristics," *Journal of Heat Transfer*, 133(5), 051502, 2011

25. **Ndao, S.**, Peles, Y., and Jensen M. K., "Multi-objective thermal design optimization and comparative analysis of electronics cooling technologies," *International Journal of Heat and Mass Transfer*, 52(19-20), pp. 4317-4326, 2009

CONFERENCE PAPERS

1. Kruse, C., Peng, E., Zuhlke, C., Shield, J., Alexander, D., **Ndao, S.**, Gogos, G., "Role of Copper Oxide Layer on Pool Boiling Performance with Femtosecond Laser Processed Surfaces," *Proceedings of the ASME 2017 International Conference on Nanochannels, Microchannels, and Minichannels*, Cambridge, Massachusetts, August 27 - 31, 2017

2. Elzouka, M., **Ndao, S.**, "NanoThermoMechanical Thermal Rectifier for high temperature thermal computing," *IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*, Orlando, Florida, May 30 – June 2, 2017

3. Elzouka, M., **Ndao, S.**, "NanoThermoMechanical Memory: Near-Field Heat Transfer Enabled Negative Differential Thermal Resistance and Thermal Latching," *15th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*, Las Vegas, NV, May 31 – June 3, 2016

4. Kruse, C., Tsubaki, A., Zuhlke, C., Anderson, T., Alexander, D., Gogos, G., **Ndao, S.**, "Study of secondary pool boiling effects with functionalized surfaces created via Femtosecond Laser Surface Processing," *15th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*, Las Vegas, NV, May 31 – June 3, 2016

5. Hassebrook, A., Lucis, M., Shield, J., Zuhlke, C., Anderson, T., Alexander, D., Gogos, G., **Ndao, S.**, "Thermal Stability of rare earth oxide coated superhydrophobic microstructured metallic surfaces," *ASME 2015 InterPACKICNMM*, San Francisco, California, July 2015

6. Zuhlke, C. A., Tsubaki, A., Kruse, C., Anderson, T., Wang, X., Downer, M. C., Gogos, G., **Ndao, S.**, Alexander, D., "Self-Organized Micro/Nanostructure Formation on Critical Heat Transfer Materials Using Femtosecond Laser Surface Processing," *ASME 2015 InterPACKICNMM*, San Francisco, California, July 2015

7. Kruse, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Pool Boiling Heat Transfer Enhancement with Metallic Femtosecond Laser Processed Surfaces: Study of Nanoparticle Effects," *9th International Conference on Boiling and Condensation Heat Transfer*, Boulder, Colorado, April 2015

8. Elzouka, M., Kulsreshath, M., **Ndao, S.**, "Modeling of Near-Field Concentrated Solar Thermophotovoltaic Microsystem," *Proceedings of the ASME 2014 International Mechanical Engineering Congress & Exposition*, Montreal, Quebec, Canada, November 2014

9. Ems, H., **Ndao, S.**, "Fabrication of Inverted Trapezoidal Microstructures for Heat Transfer and Microfluidics Applications," *12th International Conference on Nanochannels, microchannels, and Minichannels*, Chicago, Illinois, August 2014

10. Kruse, C., Anderson, T., Wilson, C., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Enhanced Pool-Boiling Heat Transfer and Critical Heat Flux Using Femtosecond Laser Surface Processing," *IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*, Orlando, Florida, May 2014

11. Hassebrook, A., Kruse, C., Wilson, C., Anderson, T., Zuhlke, C., Alexander, D., Gogos, G., **Ndao, S.**, "Effects of Droplet Diameter on the Leidenfrost Temperature of Laser Processed Multiscale Structured Surfaces," *IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*, Orlando, Florida, May 2014

12. Anderson, T., Zuhlke, C. A., Kruse, C., Wilson, C., Hassebrook, A., Somanas, I., **Ndao, S.**, Gogos, G., Alexander, D., "Tailoring liquid/solid interfacial energy transfer: fabrication and application of multiscale metallic surfaces with engineered heat transfer and electrolysis properties via femtosecond laser surface processing techniques," *SPIE Photonics West*, San Francisco, California, February 1-6 2014

13. Anderson, T., Zuhlke, C., Wilson, C., Kruse, C., **Ndao, S.**, Gogos, G., Alexander, D., "Understanding of the physics and material dynamics of multipulse femtosecond laser interactions with surfaces," Proc. SPIE 8885, *Laser-Induced Damage in Optical Materials*, 888518, November 14, 2013

14. Kruse, C., Anderson, T., Alexander, D., Gogos, G., **Ndao, S.**, "Controlling the Leidenfrost temperature through laser-assisted surface micro/nano texturing," *ASME Summer Heat Transfer Conference*, Minneapolis, Minnesota, July 2013

15. Basu S., **Ndao S.**, Michna G. J., Peles Y., Jensen M. K., "Study of CHF condition for flow boiling of R134a in circular microchannels," *14th International Heat Transfer Conference (IHTC-14)*, Washington DC, August 8-13 2010

16. Basu S., **Ndao S.**, Michna G. J., Peles Y., Jensen M. K., "Heat transfer characteristics of flow boiling of R134a in uniformly heated horizontal circular microtubes," *14th International Heat Transfer Conference (IHTC-14)*, Washington DC, August 8-13 2010

17. **Ndao, S.**, Peles, Y., and Jensen, M. K., "A genetic algorithm based multi-objective thermal design optimization of liquid cooled offset strip fin heat sinks," *ASME Summer Heat Transfer Conference*, San Francisco, CA, HT2009-88039, July 19-23 2009

Selected Funded Research Grants

- "Contaminant Sensing and Field Platform," IntelliFarm, $201,657, PI, 01/01/2018 – 06/30/2019

- "BioTransBank: A Combined Digital Platform and Smart Devices for Bio-sample Transportation and Banking," Grand Challenge Africa / IPD, $49,734, PI, 10/01/2017 - 03/31/2019

- "Boiling Heat Transfer on Femtosecond Laser Fabricated Micro/Nano Structured Surfaces," NASA, $278,028, PI, 08/01/2014 - 07/31/2018

- "NanoThermoMechanical Thermal Computing: NanoPhotonics Metamaterials for High Temperature Memories and Logic Devices," NSF/MRSEC, $100,000, PI, 11/01/2016 – 10/31/2018

- "NanoFins Heat Exchanger," NASA, $35,000, PI, 10/01/2016 – 09/30/2017

- "Functionalized Metallic Surfaces for Enhanced Heat Transfer, Drag Reduction, and Novel Power Sources," ONR, $652,407, Co-PI, 3/1/15 - 3/31/2017

- "Metallic Biomimetic Micro/Nano Structured Metallic Surcaces by Femtosecond Laser Surface Processing for Thermal Management Systems" NASA EPSCoR, $750,000, Co-PI, 8/1/2014 - 7/31/2017

- "Numerical Modeling of the Formation of Micro/ Nanostructures on Metals using Femtosecond Laser Surface Processing," Nebraska Center for Energy Sciences Research (NCESR), $250,000, Co-PI, 1/1/2014 - 12/31/2015

- "Near-Field (Nano-Gap) Concentrated Solar Thermophotovoltaic Microsystem for Space and Earth Observation Measurements," NASA EPSCoR, $62,621, PI, 9/1/2014 - 11/30/2015

- "Near-Field (Nano-Gap) Concentrated Solar Thermophotovoltaic Microsystem," Nebraska Center for Energy Sciences Research (NCESR), $120,000, PI, 1/1/2013 - 12/31/2014

- "Enhancement and Optimization of Bubble Production During Nucleate Boiling Using Multiscale Structures Fabricated by Femtosecond Laser Surface Processing: Numerical Simulations and Experiments, NASA EPSCoR, $40,000, Co-PI, 9/1/2013-5/31/2014

Patents

- Elzouka, M., **Ndao, S.** "Near-Field Heat Transfer Enabled Nanothermomechanical Memory and Logic Devices," submitted 11/13/2015, pending.

- **Ndao, S.**, Gogos, G., Alexander, D., Anderson, T. and Zuhlke, C., Provisional Patent Application Entitled "Monolithic Hierarchical Structures Micro Heat Pipe (MHSμHP)," submitted 1/12/2015, pending.

- **Ndao, S.**, Gogos, G., Alexander, D., Anderson, T. and Zuhlke, C., Provisional Patent Application Entitled "Leidenfrost Droplet Microfluidics," submitted 1/12/2015, pending.

- Anderson, T., **Ndao, S.**, Zuhlke, C., Alexander, D. and Gogos, G., Provisional Patent Application Entitled " Control of Change of Phase Through Physical Surface Shaping," submitted 1/12/2015, pending.

- Rinnerbauer, V. **Ndao, S.**, Yeng, Y. X., Bermel, P., Senkevich, J., Jensen K. F., Joannopoulos, J. D., Soljačić, M., and Celanovic, I., Photonic Crystals Comprising Polycrystalline Refractory Metals and/or Alloys and Associated Methods, 2012.

Teaching Experience

- Micro/Nano-Electro-Mechanical Systems Fabrication and Microfluidics **Spring 2015 / Fall 2016/2017**
- Heat Transfer **Fall 2013 / 2014 / 2015 / 2016 / 2017; Spring 2018**
- Micro and Nanoscale Thermal-Fluids Science and Engineering **Spring 2013 / 2014**
- **AWARDS**: Henry Y. Kleinkauf Family Distinguished New Faculty Teaching Award, 2016

Thesis Advisor and Postgraduate-Scholar Sponsor

- Ethan Davis, Graduate student (MS), MME, UNL (Defended thesis 04/20/17)
- Anton Hassebrook, Graduate student (MS), MME, UNL (Defended thesis 04/19/17)
- Mahmoud Elzouka, Graduate student (PhD), MME, UNL (Defended thesis 04/17/17)
- Mark Anderson, Graduate student (MS), MME, UNL (Alumni)
- Henry Ems, Graduate student (PhD), MME, UNL
- Corey Kruse, Graduate student (PhD), MME, UNL
- Isra Somanas, Graduate student (MS), MME, UNL (Alumni)
- Sarah Wallis, Graduate student (MS), MME, UNL (Defended thesis 11/20/17)
- Mukesh Kulsreshath, Postdoctoral associate, MME, UNL (Alumni)

Selected Internal & External Professional Services

- Member of the Mechanical & Materials Engineering Department Undergraduate Curriculum Committee
- Member of the executive committee (seven members) to oversee the operation of UNL's $3.5M NSF awarded Nebraska Nanoscience Facility.
- Panel reviewer for the National Science Foundation, Department of Energy Building Technologies Office, and ARPA-E
- Session Co-Chair, thermals for Heterogeneous Integration, ASME InterPACK, 2017, San Francisco, CA
- Topic organizer (Area: Thermal Management - Jet & Spray Cooling), ASME InterPACK / ICNMM 2015 conference, San Francisco, CA
- Member of the Regional Scientific Committee of USA, Mexico and Central America and Associate Editor of the Proceedings for the 15th International Heat Transfer Conference
- Chair of session on “Thermal Characterization Methods”, 2014 IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), Orlando, FL
- UNL’s Nebraska Center for Materials and Nanoscience NanoFab Cleanroom committee
- Journal review for:

- American Chemical Society - ACS Nano
- Langmuir
- ASME Journal of Electronic Packaging
- International Journal of Heat and Mass Transfer, IJHMT
- Journal of Applied Thermal Engineering
- International Journal of Heat and Fluid Flow
- Journal of Thermal Science and Engineering Applications