Sourabh K. Saha

Assistant Professor
George W. Woodruff School of Mechanical Engineering
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Education

Massachusetts Institute of Technology — Cambridge, MA
PhD, Mechanical Engineering — Sep 2008-Aug 2014

Thesis: "Predictive Design and Fabrication of Complex Micro and Nano Patterns via Wrinkling for Scalable and Affordable Manufacturing", Advisor: Prof. Martin Culpepper

Indian Institute of Technology Kanpur — Kanpur, India
Master of Technology and Bachelor of Technology, Mechanical Engineering — July 2003-May 2008

Master's thesis: "Experimental Investigation of the Dry Electric Discharge Machining Process", Advisor: Prof. S.K. Choudhury

Professional appointments

Georgia Institute of Technology — Aug 2019-present
Assistant Professor of Mechanical Engineering

Lawrence Livermore National Laboratory — Dec 2017-July 2019
R&D Engineer in Materials Engineering Division

Lawrence Livermore National Laboratory — June 2015-Dec 2017
Postdoctoral Research Staff Member in Precision Engineering

Gradiant Corporation, Water treatment services start-up — Nov 2014-June 2015
Manufacturing Engineering Consultant for New Products Initiation

Professional registrations

Registered Professional Engineer (Mechanical Engineering) in the states of Georgia (#PE045087), California (#38895), and Massachusetts (#55291).

Honors and awards

1. NSF CAREER Award — 2021
2. Federal Laboratory Consortium Far West Regional Award for Outstanding Technology Development on "FemtoProWrite: A Femtosecond Projection Lithography System" — 2018
3. Poster presentation awards, Materials Engineering Division, Annual LLNL Postdoc Poster Symposium — 2017, 2016
4. Best poster award, Applied Mechanics, ASME IMECE 2013 Micro-Nano Technology Forum — 2013
5. NSF student travel grant for ASME IMECE 2012 Micro-Nano Technology Forum — 2012
6. NSF graduate student fellowship for attending 2012 NSF CMMI Engineering Research and Innovation Conference — 2012
7. NSF fellowship for attending NSF Summer Institute Short Course on Materiomics — 2012
8. Graduate fellowship, Martin Family Society of Fellows for Sustainability, MIT — 2010-11
9. Pappalardo graduate fellowship, Department of Mechanical Engineering, MIT — 2008-09

Membership in professional organizations

- SME (formerly Society of Manufacturing Engineers), Member, 2018 – present
- SPIE (The International Society for Optics and Photonics), Member, 2017 – present
- American Society for Precision Engineering, Member, 2015 – present
- American Society of Mechanical Engineers, Member, 2013 – present

Professional service

- Guest Editor for special issue on additive manufacturing at SME Manufacturing Letters
- Guest Editor for ASME Journal of Micro and Nanomanufacturing, Oct. 2019 – Aug. 2020.
- Grant proposal reviewer for DFG, German Research Foundation (1 instance, 2020).
- Panel reviewer for NSF grant proposals in Engineering (1 instance, 2017).
- Conference organizing committee member, American Society for Precision Engineering (ASPE) annual meeting 2017 and ASPE winter Micro/Nano topical meetings in 2018 and 2020.
- Reviewer for journals and conferences including: Small, ASME Journal of Manufacturing Science and Engineering, ASME Journal of Micro and Nano Manufacturing, Precision Engineering, Journal of Micromechanics and Microengineering, IEEE Transactions Nanotechnology, ASME MSEC and ASPE conferences.
- Book proposal reviewer in the area of advanced manufacturing for Wiley publisher, (1 instance, 2020).
- External thesis committee member for University of Texas, Austin PhD candidate, Sep 2017 – Dec 2018.
- Course assessor of the core/required undergraduate manufacturing class for ABET accreditation of the Mechanical Engineering BS curriculum at Georgia Institute of Technology, 2019.

Teaching experience

- Instructor for core/required undergraduate class 'Design, Materials, and Manufacture', Georgia Institute of Technology, Fall 2020, Spring 2020, Fall 2019, 50-60 students per semester.
- Guest lecturer for undergraduate class 'Elements of Mechanical Design', MIT, Feb 2012, 40 students.

Students and postdoctoral scholars trained

- Thesis advisor for 2 PhD students, Georgia Tech, Fall 2019 – present.
- Undergraduate research advisor for 4 students, Georgia Tech, Spring 2020 – present.
- Research supervisor for 1 postdoctoral scholar, LLNL, Dec 2017 – May 2019.
- Research supervisor for 1 undergraduate student intern researcher, LLNL, July 2018 – March 2019.
- Research supervisor for 1 graduate student intern researcher, LLNL, June 2017 – Nov 2018.

Outreach activities

- Contributed as invited expert in the area of nanoscale additive manufacturing, DARPA Microsystems Exploratory Council (MEC) Workshop on 3D Printing Functional Microsystems, held online (in lieu of original meeting planned at Carnegie Mellon University, Pittsburgh), March 26-27, 2020.
- Developed and released open source engineering software tool, MeshPerturb: MATLAB codes for mesh perturbation and automated pre and post processing of post-bifurcation analyses via COMSOL, May 2014. http://dspace.mit.edu/handle/1721.1/86934
- Laboratory co-instructor for summer professional education course with enrollment of 15 industry professionals on 'Advanced Mechanical Design and Manufacturing', MIT, Aug. 2011.

Creative products

Granted patents

1. **S.K. Saha** and J.S. Oakdale, Optically Clear Photo-Polymerization Resists for Additive Manufacturing of Radiopaque Parts, US Patent 10,781,315, Issued Sept. 2020.
2. **S.K. Saha**, R.M. Panas, M.A. Cullinan, I.S. Ladner, Microscale Sensors for Direct Metrology of Additively Manufactured Features, US Patent 10,451,539, Issued Oct. 2019.
3. **S.K. Saha**, Method to Suppress Period Doubling during Manufacture of Micro and Nano Scale Wrinkled Structures, US Patent 10,144,172, Issued Dec. 2018.
4. **S.K. Saha** and M.L. Culpepper, Wrinkled Surfaces with Tunable Hierarchy and Methods for the Preparation Thereof, US Patent 10,052,811, Issued Aug. 2018.
5. **S.K. Saha** and M.L. Culpepper, Method to Fabricate Asymmetric Wrinkles Using Biaxial Strains, US Patent 9,950,462, Issued April 2018.
6. **S.K. Saha** and M.L. Culpepper, Method to Fabricate Pre-Patterned Surfaces during Manufacture of Complex Wrinkled Structures, US Patent 9,821,507, Issued Nov. 2017.
7. **S.K. Saha** and M.L. Culpepper, Biaxial Tensile Stage for Fabricating and Tuning Wrinkles, US Patent 9,597,833, Issued March 2017.
8. **S.K. Saha** and M.L. Culpepper, System for Passive Alignment of Surfaces, US Patent 8,834,146, Issued Sep. 2014.

Publications

Journals

1. D. Behera, S. Chizari, L. Shaw, M. Porter, R. Hensleigh, Z. Xu, N. Roy, L.G. Connolly, X. Zheng, **S.K. Saha**, J. Hopkins, M.A. Cullinan, Current Challenges and Potential Directions Towards Precision Microscale Additive Manufacturing – Part II: Laser-Based Trapping, Curing and Heating Processes, Precision Engineering, 2021. Vol. 68, pp. 301-318.
2. D. Behera, S. Chizari, L. Shaw, M. Porter, R. Hensleigh, Z. Xu, X. Zheng, X., L.G. Connolly, N.K. Roy, R.M. Panas, **S.K. Saha**, X. Zheng, J.B. Hopkins, S.-C. Chen, M.A. Cullinan, Current challenges and potential directions towards precision microscale additive manufacturing – Part IV: Future perspectives, Precision Engineering, 2021. Vol. 68, pp. 197–205.
3. X.Y. Lee, **S.K. Saha**, S. Sarkar, B. Giera, Automated Detection of Part Quality During Two-Photon Lithography via Deep Learning, Additive Manufacturing, 2020. Vol. 36, p. 101444.
4. **S.K. Saha**, S.C. Chen, Comment on 'Rapid Assembly of Small Materials Building Blocks (Voxels) into Large Functional 3D Metamaterials, Advanced Functional Materials, 2020. DOI: 10.1002/adfm.202001060.
5. D. Cayll, I.S. Ladner, J.H. Cho, **S.K. Saha**, M. Cullinan, A MEMS Dynamic Mechanical Analyzer for in situ Viscoelastic Characterization of 3D Printed Nanostructures, Journal of Micromechanics and Microengineering, 2020. Vol. 30(7), p. 075008.
6. **S.K. Saha**, D. Wang, V.H. Nguyen, Y. Chang, J.S. Oakdale, S. Chen, Scalable Submicrometer Additive Manufacturing, Science, 2019. Vol. 366 (6461), pp. 105 -109.
7. I.S. Ladner, M.A. Cullinan, **S.K. Saha**, Tensile Properties of Polymer Nanowires Fabricated via Two-photon Lithography, RSC Advances, 2019. Vol. 9, pp. 28808-28813.
8. **S.K. Saha**, B. Au, J.S. Oakdale, High-speed Direct Laser Writing of Silver Nanostructures via Two-photon Reduction, Advanced Engineering Materials, 2019. Vol. 21, p. 1900583.

9. **S.K. Saha**, J.S. Oakdale, J.A. Cuadra, C. Divin, J. Ye, J.-B. Forien, L. Bayu Aji, J. Biener, W.L. Smith, Radiopaque Resists for Two-photon Lithography to Enable Submicron 3D Imaging of Polymer Parts via X-ray Computed Tomography, ACS Applied Materials & Interfaces, 2018. Vol. 10, Issue 1, pp. 1164-1172. (On journal cover)

10. **S.K. Saha**, T.M. Uphaus, J.A. Cuadra, C. Divin, I.S. Ladner, K.G. Enstrom, R.M. Panas, Kinematic Fixtures to Enable Multi-Material Printing and Rapid Non-Destructive Inspection During Two-Photon Lithography, Precision Engineering, 2018. Vol. 54, pp. 131-137.

11. **S.K. Saha**, C. Divin, J.A. Cuadra, R.M. Panas, Effect of Proximity of Features on the Damage Threshold during Submicron Additive Manufacturing via Two-Photon Polymerization, ASME Journal of Micro and Nano-Manufacturing, 2017. Vol. 5, Issue 3, p. 031002.

12. **S.K. Saha**, Geometric Prepatterning-Based Tuning of the Period Doubling Onset Strain During Thin-Film Wrinkling, ASME Journal of Applied Mechanics, 2017. Vol. 84, Issue 5, p. 051010.

13. **S.K. Saha**, Sensitivity of the Mode Locking Phenomenon to Geometric Imperfections during Wrinkling of Supported Thin Films, International Journal of Solids and Structures, 2017. Vol. 109C, pp. 166-179.

14. **S.K. Saha** and M.L. Culpepper, Deterministic Switching of Hierarchy during Wrinkling in Quasi-planar Bilayers, Advanced Engineering Materials, 2016. Vol. 18, Issue 6, pp. 938-943.

15. **S.K. Saha** and M.L. Culpepper, Design of a Compact Biaxial Tensile Stage for Fabrication and Tuning of Complex Micro-and Nano-scale Wrinkle Patterns, ASME Journal of Micro and Nano-Manufacturing, 2015. Vol. 3, Issue 4, 041004.

16. **S.K. Saha** and M.L. Culpepper, Characterization of the Dip Pen Nanolithography Process for Nanomanufacturing, ASME Journal of Manufacturing Science and Engineering, 2011. Vol. 133, Issue 4, 041005.

17. A.H. Slocum Jr., **S.K. Saha**, and M.L. Culpepper, Metric Mapping: A New Method to Aid in the Design of Nano-Manufacturing Systems, International Journal of Nanomanufacturing, 2011. Vol. 7, No. 2, pp. 143–157.

18. **S.K. Saha** and M.L. Culpepper, An Ink Transport Model for Prediction of Feature Size in Dip Pen Nanolithography, The Journal of Physical Chemistry C, 2010. 114(36), pp. 15364–15369.

19. **S.K. Saha** and M.L. Culpepper, A Surface Diffusion Model for Dip Pen Nanolithography Line Writing, Applied Physics Letters, 2010. 96, 243105.

20. **S.K. Saha** and S.K. Choudhury, Experimental Investigation and Empirical Modeling of the Dry Electric Discharge Machining Process, International Journal of Machine Tools and Manufacture, 2009. Vol. 49, 3-4, pp. 297–308.

21. F. Salaun, E. Devaux, S. Bourbigot, P. Rumeau, P.O. Chapuis, **S.K. Saha**, and S. Volz, Polymer Nanoparticles to Decrease Thermal Conductivity of Phase Change Materials, Thermochimica Acta, 2008. Vol. 477, 1-2, pp. 25–31.

Conference proceedings

1. H. Kim, **S.K. Saha**, Defect Control during Femtosecond Projection Two-photon Lithography, Procedia Manufacturing, Special issue: 48th SME North American Manufacturing Research Conference, NAMRC 48, 2020. Vol. 48, pp. 650-655.

2. V.H. Nguyen, D. Wang, J.S. Oakdale, S. Chen, **S.K. Saha***, Breaking the Resolution Versus Throughput Tradeoff in Nanoscale Additive Manufacturing, ASPE Annual meeting, Pittsburgh, PA, Oct. 28 – Nov. 1, 2019.

3. V.H. Nguyen, J.S. Oakdale, S. Chen, **S.K. Saha**, Dosage Compensation for Uniform Printing with Non-uniform Beams in Projection Two-Photon Lithography, ASPE Summer Topical Meeting 2018 on Advancing Precision in Additive Manufacturing, Berkeley, CA, July 22-25, 2018.

4. I.S. Ladner, J.H. Cho, D.R. Cayll, V.H. Nguyen, M.A. Cullinan, **S.K. Saha**, Mechanical Characterization of Additively Manufactured Microstructures Using a Process Integrated MEMS Tensile Tester, Hilton Head Workshop 2018: A Solid-State Sensors, Actuators and Microsystems Workshop, Hilton Head Island, SC, June 3-7, 2018.

5. I.S. Ladner, **S.K. Saha**, A. Cao, M. Cullinan, Design of High Resolution and High Force MEMS Tensile Testers for Direct Metrology of Additively Manufactured Submicron Features, ASPE Annual meeting, Charlotte, NC, Oct. 29 – Nov. 3, 2017.

6. V. Nguyen, J.A. Cuadra, C. Divin, J. Oakdale, **S.K. Saha**, Loss of Dimensional Accuracy due to Non-uniform Shrinkage in Additively Manufactured Polymer Parts Fabricated by Two-photon Lithography, EUSPEN Special Interest Group Meeting: Additive Manufacturing, Leuven, Belgium, Oct. 2017.

7. **S.K. Saha***, P. Fitsos, J.A. Cuadra, C. Divin, R.M. Panas, Process and Equipment Driven Limits to the Performance of Two-Photon Polymerization Based Submicron Additive Manufacturing, 31st Annual Meeting of the American Society for Precision Engineering. Portland OR, Oct. 2016.

8. **S.K. Saha***, C. Divin, J.A. Cuadra, R.M. Panas, Part Damage Due to Proximity Effects During Sub-Micron Additive Manufacturing Via Two-Photon Lithography, ASME Manufacturing Science and Engineering Conference, Blacksburg, VA, June 27-July 1 2016.

9. **S.K. Saha*** and M.L. Culpepper, Predicting the Quality of One-Dimensional Periodic Micro and Nano Structures Fabricated Via Wrinkling, ASME 2012 International Mechanical Engineering Congress and Exposition. Houston TX, USA, Nov. 2012.

10. **S.K. Saha***, J.J. LaColla, and M.L. Culpepper, An Automated Stage for Scalable Imprinting of DNA Nanowires Based on a Self-Aligning Technique, ASME 2012 International Mechanical Engineering Congress and Exposition. Houston TX, USA, Nov. 2012.

11. **S.K. Saha**, C.M. DiBiasio, A.H. Slocum Jr., A. Watral, and M.L. Culpepper, Precision Equipment and Tools that Enable Practical Probe-based Nanomanufacturing, 10th International Conference of the European Society for Precision Engineering and Nanotechnology. Delft, Netherlands, June 2010.

12. **S.K. Saha** and M.L. Culpepper, Process Modeling of Dip Pen Nanolithography Line Writing for Accurate Line Width Control in Nanomanufacturing, 24th Annual Meeting of the American Society for Precision Engineering. Monterey CA, USA, Oct. 2009.

13. P.O. Chapuis, **S.K. Saha**, and S. Volz, Quantitative 3ω-Scanning Thermal Microscopy: Modelling the AC/DC coupling and the sample heat conduction, 12th International Workshop on Thermal investigations of ICs. Nice, France, Sep. 2006.

*Delivered technical talk at conference

Invited technical talks

1. High-throughput Nanoscale Additive Manufacturing, GTMI Lunch and Learn Seminar Series, Georgia Institute of Technology, Oct. 2020.

2. High-throughput Nanoscale Additive Manufacturing, NanoGe Online Meetup Conference: Nanocrystals in Additive Manufacturing, May 2020.

3. Process Modeling and System Design for Scalable and Affordable Nanomanufacturing, Department of Mechanical Engineering, University of Texas at Austin, Jan. 2019.

4. From Niche Fabrication to Scalable Manufacturing: The Case of Two-Photon Lithography, Biological Engineering and Small-scale Technologies Seminar, University of California Merced, Oct. 2018.
5. Process Modeling and System Design for Scalable and Affordable Nanomanufacturing, Department of Aerospace & Mechanical Engineering, University of Southern California, March 2018.
6. Process Modeling and System Design for Scalable and Affordable Nanomanufacturing, Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Feb. 2018.
7. Process Modeling and Equipment Design to Enable Scalable Template-free Micro and Nano Manufacturing, Post-doctoral Seminar at Lawrence Livermore National Laboratory, March 2015.
8. Design and Manufacturing for the Nano-scale, Company Specific In-house Competency and Leadership Development Program at Heavy Engineering Corporation Limited. Ranchi, India, Jan. 2012.

Technical presentations at conferences

1. Projection two-photon lithography for high-throughput nanoscale 3D printing, Techconnect World Innovation Conference and Expo, Boston, June 2019.
2. Parallel Two-photon Lithography with Sub-diffraction Voxel Shaping, 29th Annual International Solid Freeform Fabrication Symposium - An Additive Manufacturing Conference, Austin, Aug. 2018.
3. Scalable Submicron Additive Manufacturing Based on Two-photon Lithography, MRS Spring Meeting 2018, Phoenix, April 2018.
4. Parallel Two-photon Lithography for 3D Printing of Millimeter Scale Parts with Submicron Features, Photonics West 2018, San Francisco, Jan. 2018.
5. Sensitivity of the Compression-softening Effect to Mesh Imperfections in Compressed Flexures, COMSOL User Conference 2014, Boston, Oct. 2014.
6. Directing the Wrinkling Process to Generate Non-uniform Micro and Nano Scale Patterns, MRS Fall Meeting 2013, Boston, Dec. 2013.
7. Studying the Sensitivity of the Wrinkling Process to Mesh Imperfections Using COMSOL Multiphysics and LiveLink for MATLAB, COMSOL User Conference 2013, Boston, Oct. 2013.