# Sushobhan Avasthi

Assistant Professor

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## Research Interests

**Photovoltaics**: Si/metal-oxide and Si/organic heterojunction solar cells. Hybrid and inorganic perovskite solar cells. Solar cells on steel
**Metal-oxides**: High-mobility p-channel metal-oxide TFTs and functional metal-oxides.

## Education

2005-11 **Doctor of Philosophy** in Electrical Engineering, Princeton University, USA
Thesis: Crystalline-Silicon/Organic Heterojunctions for Solar Photovoltaics
Advisor: James C. Sturm, Professor of Electrical Engineering.

2005-07 **Master of Arts** in Electrical Engineering, Princeton University, USA

2001-05 **Bachelor of Technology** in Electrical Engineering, Indian Institute of Technology Kanpur, India

## Work Experience

2014-* **Assistant Professor** at Indian Institute of Science (IISc), India
Currently at the Centre for Nano Science and Engineering (CeNSE)

2011-14 **Postdoctoral Research Associate** at Princeton University, USA
Pursued research in silicon/metal-oxide heterojunctions for photovoltaics at the Princeton Institute for the Science and Technology of Materials (PRISM).

2011-12 **Founder** of SuryaTech LLC, USA
Co-founder of SuryaTech, a startup to commercialize the silicon heterojunction solar cell developed during my doctorate. Worked closely with the angel and venture-capital community in New Jersey, USA.

## Awards & Associations

2018 **INAE Young Associate**

2018 **INAE Young Engineer Award**
Awarded for engineering research, excellence in engineering design, technology development and technology transfer by Indian National Academy of Engineering (INAE)

2016 **Young Faculty Research Fellowship**
Awarded under the Visvesvaraya PhD Scheme for Electronics and IT by DeitY. Government of India

2011 **Prize at 6th Princeton Innovation Forum**
Innovation Forum was a business case competition that provided seed funding for my startup.

2010 **Edith and Martin B. Stein Solar Energy Innovation Award**
From the Global Photonic Energy Corporation for pioneering contribution in the field of solar energy.

2009 **Materials Research Society Student Poster Award**, Fall Meeting 2009 at Boston, MA.
Selected from a pool of more than 100 posters presented at the meeting.

2005 **Motorola Student of the Year**, IIT Kanpur
For outstanding performance among the 120 students of Electrical Engg. and Computer Science & Engg.

## Teaching

**NE314: Semiconductor Optoelectronics and Photovoltaics (Credit 3:0)**

*Offered in the spring semester.*

An advanced graduate level course designed for students who have a background in semiconductor device physics, NE314 provides a detailed review of optoelectronic devices such as LEDs, photodetectors and solar cells. The focus is more on the device physics, although some material and fabrication issues are also discussed.

**NE203: Advanced Micro & Nano Fabrication Technology & Processes (Credit 3:0)**

*Offered in the fall semester.*

The course provides an in-depth understanding of the various unit processes in micro & nano fabrication, including crystal growth, doping, vapor deposition, photolithography, wet etching, dry etching, and packaging. The course is accessible to students from diverse backgrounds, such as materials, physics, chemistry, mechanical engineering, and electrical engineering.

**NE202: Micro and Nano Fabrication (Credit 0:1)**

*Offered both semesters.*

The course provides hands-on exposure to semiconductor device fabrication. NE202 is a laboratory-only course with one session per week. Students participate in fabrication of a solar cell, a MOS capacitor, a graphene FET, a MEMS cantilever. The course also includes a term project, in which groups of 3-4 students either fabricate a complete device or optimize a unit process.

## Peer-Reviewed Publications


[1] A. S. Chouhan, N. P. Jasti, and S. Avasthi, "The dual role of ozone-treated aluminum doped zinc oxide for $CH_3NH_3PbI_3$ solar cells," *Organic Electronics*, Dec. 2018, issn: 1566-1199. doi: {10.1016/j.orgel.2018.12.030}.

[2] V. K. Singh, J. Nagaraju, and S. Avasthi, "Radial junction silicon solar cells with micro-pillar array and planar electrode interface for improved photon management and carrier extraction," *Current Applied Physics*, Dec. 2018, issn: 1567-1739. doi: https://doi.org/10.1016/j.cap.2018.12.016.

[3] S. Chaurasia, N. Mohan, S. Raghavan, and S. Avasthi, "Wafer-scale epitaxial germanium (100), (111), (110) films on silicon using liquid phase crystallization," *AIP Advances*, vol. 8, no. 7, p. 075 010, Jul. 2018. doi: 10.1063/1.5033324.

[4] A. S. Chouhan, N. P. Jasti, and S. Avasthi, "Effect of interface defect density on performance of perovskite solar cell: Correlation of simulation and experiment," *Materials Letters*, vol. 221, pp. 150–153, Jun. 2018, issn: 0167-577X. doi: https://doi.org/10.1016/j.matlet.2018.03.095.

[5] A. S. Chouhan, E. Athresh, R. Ranjan, S. Raghavan, and S. Avasthi, "$BaBiO_3$: A potential absorber for all-oxide photovoltaics," *Materials Letters*, vol. 210, pp. 218–222, Jan. 2018, issn: 0167-577X. doi: 10.1016/j.matlet.2017.09.038.

[6] A. Singh, A. S. Chouhan, and S. Avasthi, "Methylamine vapor exposure for improved morphology and stability of cesium-methylammonium lead halide perovskite thin-films," *The Physics of Semiconductor Devices, Springer Proceedings in Physics*, vol. 215, 2018, issn: 978-3-319-97603-7. doi: 10.1007/978-3-319-97604-4_61.

[7] A. Singh, S. K. Podapangi, and S. Avasthi, "Cation exchange assisted dimensional down-conversion of perovskite thin films using vapor annealing: An interplay of tolerance factor," *Integrated Ferroelectric*, 2018, issn: 1607-8489. doi: 10.1080/10584587.2018.1514866.

[8] T. Biswas, P. Ravindra, E. Athresh, R. Ranjan, S. Avasthi, and M. Jain, "Optical Properties of $Zn_2Mo_3O_8$: Combination of Theoretical and Experimental Study," *The Journal of Physical Chemistry C*, vol. 121, no. 44, pp. 24 766–24 773, Nov. 2017, issn: 1932-7447. doi: 10.1021/acs.jpcc.7b07473.

[9] P. Ravindra, R. Mukherjee, and S. Avasthi, "Hole-Selective Electron-Blocking Copper Oxide Contact for Silicon Solar Cells," *IEEE Journal of Photovoltaics*, vol. 7, no. 5, pp. 1278–1283, Sep. 2017, issn: 2156-3381. doi: 10.1109/JPHOTOV.2017.2720619.

[10] A. S. Chouhan, N. P. Jasti, S. Hadke, S. Raghavan, and S. Avasthi, "Large grained and high charge carrier lifetime $CH_3NH_3PbI_3$ thin-films: Implications for perovskite solar cells," *Current Applied Physics*, vol. 17, no. 10, pp. 1335–1340, 2017, issn: 1567-1739. doi: https://doi.org/10.1016/j.cap.2017.07.005.

[11] K. A. Nagamatsu, S. Avasthi, G. Sahasrabudhe, G. Man, J. Jhaveri, A. H. Berg, J. Schwartz, A. Kahn, S. Wagner, and J. C. Sturm, "Titanium dioxide/silicon hole-blocking selective contact to enable double-heterojunction crystalline silicon-based solar cell," *Applied Physics Letters*, vol. 106, no. 12, p. 123 906, 2015. doi: 10.1063/1.4916540.

[12] K. A. Nagamatsu, S. Avasthi, J. Jhaveri, and J. C. Sturm, "A 12% Efficient Silicon/PEDOT:PSS Heterojunction Solar Cell Fabricated at <100 °C," *IEEE Journal of Photovoltaics*, vol. 4, no. 1, pp. 260–264, Jan. 2014, issn: 2156-3381. doi: 10.1109/JPHOTOV.2013.2287758.

[13] S. Avasthi, W. E. McClain, G. Man, A. Kahn, J. Schwartz, and J. C. Sturm, "Hole-blocking titanium-oxide/silicon heterojunction and its application to photovoltaics," *Applied Physics Letters*, vol. 102, no. 20, p. 203 901, 2013. doi: 10.1063/1.4803446.

[14] J. Sturm, S. Avasthi, K. Nagamatsu, J. Jhaveri, W. E. McClain, G. Man, A. Kahn, J. Schwartz, and S. Wagner, "(invited) wide bandgap heterojunctions on crystalline silicon," *ECS Transactions*, vol. 58, no. 9, pp. 97–105, 2013. doi: 10.1149/05809.0097ecst.

[15] S. Avasthi, S. Lee, Y.-L. Loo, and J. C. Sturm, "Role of Majority and Minority Carrier Barriers Silicon/Organic Hybrid Heterojunction Solar Cells," *Advanced Materials*, vol. 23, no. 48, pp. 5762–5766, 2011, issn: 1521-4095. doi: 10.1002/adma.201102712.

[16] S. Avasthi, Y. Qi, G. K. Vertelov, Jeffrey Schwartz, A. Kahn, and J. C. Sturm, "Electronic structure and band alignment of 9,10-phenanthrenequinone passivated silicon surfaces," *Surface Science*, vol. 605, no. 13-14, pp. 1308–1312, 2011, issn: 0039-6028. doi: 10.1016/j.susc.2011.04.024.

[17] ——, "Silicon surface passivation by an organic overlayer of 9,10-phenanthrenequinone," *Applied Physics Letters*, vol. 96, no. 22, p. 222 109, 2010. doi: 10.1063/1.3429585.

[18] S. Shankar, A. M. Tyryshkin, S. Avasthi, and S. A. Lyon, "Spin resonance of 2d electrons in a large-area silicon MOSFET," *Physica E: Low-dimensional Systems and Nanostructures*, vol. 40, no. 5, pp. 1659–1661, 2008, issn: 1386-9477. doi: https://doi.org/10.1016/j.physe.2007.10.030.

## Conference Presentations & Proceedings

[1] R. Mukherjee, P. Singh, S. K. Podapangi, and S. Avasthi, "Improvement in morphology and carrier lifetime by inclusion of magnesium in the perovskite matrix," 4th International Conference on Perovskite Solar Cells and Optoelectronics, Lausanne, Switzerland, Sep. 2018.

[2] S. Chaurasia, S. Raghavan, and S. Avasthi, "High quality epitaxial germanium on si (110) using liquid phase epitaxy for low-cost iii-v solar cells," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8548031.

[3] A. S. Chouhan, N. P. Jasti, and S. Avasthi, "Ozone-treated aluminum doped zinc oxide for ETL-free stable perovskite solar cells," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8548178.

[4] R. Mukherjee, P. Srivastava, P. Ravindra, and S. Avasthi, "Doped cu2o/ n-si heterojunction solar cell," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8547485.

[5] P. N. and S. Avasthi, "Modified transport-layer interfaces for efficient and hysteresis-free planar-perovskite solar cells," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8547734.

[6] P. Ravindra, S. Kumar, E. Athresh, A. Jash, R. Ranjan, and S. Avasthi, "Demonstration of a new oxide absorber $ag_2cro_4$ using top-contacted schottky cells," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8547482.

[7] A. Singh and S. Avasthi, "Vapor induced recrystallization of methylammonium tin iodide perovskite for enhanced stability," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8547989.

[8] P. Srivastava, R. Mukherjee, V. N. Viswanathan, P. C. Ramamurthy, and S. Avasthi, "Higher open-circuit voltage and stability in mapbi3 perovskite solar cells using a bilayer hole-transport layer with a d-a-d architectured polymer," in *2018 IEEE 7th World Conference on Photovoltaic Energy Conversion (WCPEC) (A Joint Conference of 45th IEEE PVSC, 28th PVSEC 34th EU PVSEC)*, Waikoloa, HI, USA, Jun. 2018. doi: 10.1109/PVSC.2018.8548001.

[9] S. Chaurasia, A. Chatterjee, S. Selvaraja, and S. Avasthi, "Infrared (IR) photo-resistors based on re-crystallized amorphous germanium films on silicon using liquid phase crystallization," vol. 10680, Strasbourg, France, Apr. 2018. doi: 10.1117/12.2319148.

[10] A. Singh, A. S. Chouhan, and S. Avasthi, "Highly crystalline methylammonium tin iodide perovskite films using post-deposition methylamine vapor annealing for improved grain size," 2018 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2018.

[11] ——, "Methylamine vapor annealing for improved morphology and stability of caesium-methylamine lead halide perovskite thin-films," XIX International Workshop on The Physics of Semiconductor Devices (IWPSD), New Delhi, India, Dec. 2017.

[12] A. Singh, S. Podapangi, A. S. Chouhan, and S. Avasthi, "Cation exchange for 3d-2h transformation of perovskite thin films using vapour annealing: An interplay of tolerance factor," International Symposium on Integrated Functionalities 2017, New Delhi, India, Dec. 2017.

[13] S. Chaurasia, S. Raghavan, and S. Avasthi, "High quality epitaxial germanium on si (111) using a two-step annealing process," International Conference on Thin Films (ICTF) 2017, New Delhi, India, Nov. 2017.

[14] A. Singh, A. S. Chouhan, and S. Avasthi, "Interaction of humidity and polar molecules with mixed cation perovskite for high efficiency solar cells: Materials and device study," International Conference on Thin Films (ICTF) 2017, New Delhi, India, Nov. 2017.

[15] S. Chaurasia, A. S. Chouhan, S. Raghavan, and S. Avasthi, "High-quality gaas (100) thin films on silicon (100) using epitaxial germanium (100) buffer for low-cost iii-v solar cells," 33rd European Photovoltaic Solar Energy Conference and Exhibition, Amsterdam, NE, Sep. 2017.

[16] A. S. Chouhan, N. P. Jasti, and S. Avasthi, "Charge carrier lifetime in $ch_3nh_3pbi_3$ thin film: Role of humidity," 33rd European Photovoltaic Solar Energy Conference and Exhibition, Amsterdam, NE, Sep. 2017.

[17] S. Chaurasia, S. Raghavan, and S. Avasthi, "Laser crystallization of amorphous germanium on titanium nitride-coated steel for low-cost gaas solar-cells," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[18] ——, "High quality epitaxial germanium on si (100) for low -cost iii-v solar-cells," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[19] A. S. Chouhan, N. P. Jasti, and S. Avasthi, "Perovskite grain size modulation by annealing in methylamine environment," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[20] K. Kumari and S. Avasthi, "Grain boundaries in thin-film polycrystalline gaas solar cells: A simulation study," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[21] P. Ravindra, E. Athresh, R. Ranjan, S. Raghavan, and S. Avasthi, "Electro-optical properties of $zn_2mo_3o_8$ thin-films: A novel low-bandgap solar absorber," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[22] ——, "Effect of annealing on performance of solar cell with new oxide absorber $mn_2v_2o_7$," 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington D.C., USA, Jun. 2017.

[23] S. Chaurasia, S. Raghavan, and S. Avasthi, "Characterization of titanium nitride as iron diffusion barrier for gaas thin film solar cell on steel," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[24] ——, "Liquid phase epitaxy for growth of high-quality crystalline germanium (100) on silicon (100) wafers," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[25] A. S. Chouhan, N. P. Jasti, and R. B. I. S. Avasthi, "Compact-$tio_2$ deposited via ald for highly-repeatable and low-hysteresis perovskite solar cells," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[26] K. Kumari and S. Avasthi, "Effects of columnar grain boundaries on thin film polycrystalline gaas solar cells," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[27] R. Mukherjee, P. Ravindra, and S. Avasthi, "Ultra-thin $sio_2$ layers for defect-free si/oxide carrier selective contacts," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[28] P. Ravindra and S. Avasthi, "Zinc molybdenum oxide - a new solar absorber," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[29] P. Ravindra, R. Mukherjee, and S. Avasthi, "$Cu_2o$/si heterojunction based carrier selective contact for silicon photovoltaics," 2017 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2017.

[30] S. Chaurasia, S. Raghavan, and S. Avasthi, "Epitaxial germanium thin films on silicon (100) using two-step process," in *2016 3rd International Conference on Emerging Electronics (ICEE)*, Dec. 2016, pp. 1–4. doi: 10.1109/ICEmElec.2016.8074631.

[31] S. Chaurasia, S. Raghavan, and S. Avasthi, "Ohmic contact formation between titanium nitride and n type germanium thin films," International Conference of Young Researchers on Advanced Materials, International Union of Materials Research Society, Materials Research Society), Bangalore, India, Dec. 2016.

[32] ——, "Epitaxial germanium films on silicon(100) for heterogeneous integration with silicon photonics," International Conference of Young Researchers on Advanced Materials, International Union of Materials Research Society, Materials Research Society), Bangalore, India, Dec. 2016.

[33] K. Kumari, A. Jayanthi, and S. Avasthi, "Effect of grain-boundaries on efficiency of thin-film gallium arsenide solar cells with columnar grain structure," International Conference of Young Researchers on Advanced Materials, International Union of Materials Research Society, Materials Research Society), Bangalore, India, Dec. 2016.

[34] P. Ravindra and S. Avasthi, "Zinc-molybdenum-oxide: A new solar absorber," International Conference of Young Researchers on Advanced Materials, International Union of Materials Research Society, Materials Research Society), Bangalore, India, Dec. 2016.

[35] V. K. Singh and S. Avasthi, "Tunnel diodes for perovskite/silicon tandem solar cell," International Conference of Young Researchers on Advanced Materials, International Union of Materials Research Society, Materials Research Society), Bangalore, India, Dec. 2016.

[36] ——, "Fabrication of esaki tunnel diode for silicon/pervoskite tandem cell," Conference on Emerging Materials 2016 (CEMAT-2016), Bangalore, India, Jul. 2016.

[37] A. Chaudhary, N. Ravishankar, S. Avasthi, and S. Raghavan, "3d $ti/tio_2$ photoelectrodes for sensitized solar cells," 2016 IEEE 43rd Photovoltaic Specialist Conference (PVSC), Portland, OR, USA, Jun. 2016.

[38] P. Ravindra and S. Avasthi, "Electron-blocking properties of crystalline-silicon/$cu_2o$ heterojunctions for photovoltaics," 2016 Spring Meeting of Material Research Society, Phoenix, AZ, USA, Apr. 2016.

[39] S. Avasthi, K. A. Nagamatsu, J. Jhaveri, W. E. McClain, G. Man, A. Kahn, J. Schwartz, S. Wagner, and J. C. Sturm, "Double-heterojunction crystalline silicon solar cell fabricated at 250 °c with 12.9% efficiency," in *2014 IEEE 40th Photovoltaic Specialist Conference (PVSC)*, Jun. 2014, pp. 0949–0952. doi: 10.1109/PVSC.2014.6925069.

[40] J. Jhaveri, S. Avasthi, K. Nagamatsu, and J. C. Sturm, "Stable low-recombination n-si/tio2 hole-blocking interface and its effect on silicon heterojunction photovoltaics," in *2014 IEEE 40th Photovoltaic Specialist Conference (PVSC)*, Jun. 2014, pp. 1525–1528. doi: 10.1109/PVSC.2014.6925206.

[41] S. Avasthi, W. E. McClain, G. Man, J. Jhaveri, K. A. Nagamatsu, A. Kahn, J. Schwartz, and J. C. Sturm, "Growth mechanism and carrier transport in hole-blocking $tio_2$/silicon heterojunctions," 2014 Spring Meeting of Material Research Society, San Francisco, CA, USA, Mar. 2014.

[42] S. Avasthi, Y. McClain Afsar, G. Man, J. Jhaveri, K. A. Nagamatsu, A. Kahn, J. Schwartz, S. Wagner, and J. C. Sturm, "Hole-blocking metal-oxide/crystalline-silicon heterojunctions with recombination velocity of $< 100$ cm/s," 2014 Spring Meeting of Material Research Society, San Francisco, CA, USA, Mar. 2014.

[43] J. Jhaveri, S. Avasthi, G. Man, K. A. Nagamatsu, W. E. McClain, J. Schwartz, A. Kahn, and J. C. Sturm, "Effect of annealing on stability of low interface recombination velocity at $tio_2$/p-silicon interface," 2014 Spring Meeting of Material Research Society, San Francisco, CA, USA, Mar. 2014.

[44] K. A. Nagamatsu, J. Spechler, S. Avasthi, C. B. Arnold, and J. C. Sturm, "Silicon/organic heterojunction photovoltaic cell with 12.7% efficiency by use of spray-coated nanowire transparent conductor," 2014 Spring Meeting of Material Research Society, San Francisco, CA, USA, Mar. 2014.

[45] J. Jhaveri, S. Avasthi, G. Man, W. . McClain, K. A. Nagamatsu, A. Kahn, J. Schwartz, and J. C. Sturm, "Hole-blocking crystalline-silicon/titanium-oxide heterojunction with very low interface recombination velocity," in *Photovoltaic Specialists Conference (PVSC), 2013 IEEE 39th*, Jun. 2013, pp. 3292–3296. doi: 10.1109/PVSC.2013.6745154.

[46] J. Jhaveri, S. Avasthi, K. A. Nagamatsu, and J. C. Sturm, "Wide bandgap hbt on crystalline silicon using electron-blocking pedot:pss emitter," in *71st Device Research Conference*, Jun. 2013, pp. 77–78. doi: 10.1109/DRC.2013.6633801.

[47] K. A. Nagamatsu, S. Avasthi, J. Jhaveri, and J. C. Sturm, "12% efficient silicon/pedot:pss heterojunction solar cell fabricated at <100 °c," 39th IEEE Photovoltaic Specialists Conference, Tampa, FL, USA, Jun. 2013.

[48] K. A. Nagamatsu, S. Avasthi, J. Spechler, C. B. Arnold, and J. C. Sturm, "Current mechanisms in silicon-organic heterojunction solar cells with transfer printed metallization," 2012 Fall Meeting of Material Research Society, Boston, MA, USA, Dec. 2012.

[49] S. Avasthi, W. McClain, J. Schwartz, and J. C. Sturm, "Hole-blocking tio2/silicon heterojunction for silicon photovoltaics," in *Device Research Conference (DRC), 70th*, IEEE, Jun. 2012, pp. 93–94. doi: 10.1109/DRC.2012.6256955.

[50] S. Avasthi and J. C. Sturm, "Charge separation and minority carrier injection in p3ht-silicon heterojunction solar cells," in *Photovoltaic Specialists Conference (PVSC), 2011 37th IEEE*, Seattle, WA, USA, Jun. 2011, pp. 002 487–002 489. doi: 10.1109/PVSC.2011.6186450.

[51] S. Avasthi, S. Lee, Y.-L. Loo, and J. C. Sturm, "The role of p3ht barriers in p3ht-silicon heterojunction solar cells with a high open-circuit voltage," 2011 Spring Meeting of Material Research Society, San Francisco, CA, USA, Mar. 2011.

[52] S. Avasthi, Y. Qi, S. Ha, G. Vertelov, J. Schwartz, A. Kahn, and J. C. Sturm, "P3ht-silicon organic-silicon heterojunction for photovoltaic applications," 2010 Fall Meeting of Material Research Society, Boston, MA, USA, Dec. 2010.

[53] S. Avasthi, Y. Qi, G. Vertelov, J. Schwartz, A. Kahn, and J. C. Sturm, "Stability of electrical properties of silicon (100) surfaces passivated with 9,10-phenanthrenequinone," 2009 Fall Meeting of Material Research Society, Boston, MA, USA, Dec. 2009.

[54] J. C. Sturm, B. Hekmatshoar, L. Han, S. Avasthi, G. Vertelov, Y. Qi, J. Schwartz, A. Kahn, and S. Wagner, "Towards organic-based dielectrics for low-temperature silicon -based devices for large-area electronics," 2009 Fall Meeting of Material Research Society, Boston, MA, USA, Dec. 2009.

[55] S. Avasthi, G. Vertelov, J. Schwartz, and J. C. Sturm, "Reduction of minority carrier recombination at silicon surfaces and contacts using organic heterojunctions," in *Photovoltaic Specialists Conference (PVSC), 2009 34th IEEE*, 2009, pp. 001 681–001 685. doi: 10.1109/PVSC.2009.5411419.

[56] S. Avasthi, Y. Qi, J. Schwartz, A. Kahn, and J. C. Sturm, "Electronic passivation of silicon (100) surfaces by organic layer of 9,10-phenanthrenequinone," 51st Electronic Materials Conference, College Park, PA, USA, Jun. 2007.

[57] S. Shankar, A. Tyryshkin, S. Avasthi, and S. Lyon, "Electron spin resonance of electrons in a large-area silicon mosfet," in *APS Meeting Abstracts*, Mar. 2007, B43.009.

## Patents

[1] S. Chaurasia, S. Raghavan, N. Bhat, and S. Avasthi, "Solar panel assembly," Indian Patent 201 741 007 845, 2017.

[2] S. Avasthi, W. E. McClain, J. Schwartz, and J. C. Sturm, "Hole-blocking $tio_2$/silicon heterojunction for silicon photovoltaics," US Patent application 14/385,347, 2013.

[3] ——, "Hole-blocking $tio_2$/silicon heterojunction for silicon photovoltaics," PCT 13761284.2 - 1555, 2013.

[4] Y. Huang, S. Avasthi, K. A. Nagamatsu, and J. C. Sturm, "Silicon/organic heterojunction (soh) solar cell and roll-to-roll fabrication process for making same," US Patent Application 13/467,515, 2012.

[5] S. Avasthi, J. Schwartz, and J. C. Sturm, "Photovoltaic device and method of making the same," Taiwan Patent 100 118 094, 2010.

[6] ——, "Photovoltaic device and method of making the same," US Patent Application 13/113,606, 2010.

## Grants

| | Title | PI/ Co-PI | Program, Agency | Amount (lakhs) | Duration |
|---|---|---|---|---|---|
| 1 | Ge-on-Steel for Flexible Thin-Film Solar Cells | PI | Synergy Projects, Office of PSA | 230.80 | 2017-19 |
| 2 | Hole-conducting copper (+1)-oxide semiconductors for thin-film transistors | PI | NSAG-I, DST | 118.26 | 2017-20 |
| 3 | Crystalline-silicon/perovskite tandem solar cell for high-efficiency photovoltaics | PI | SERB, DST | 54.98 | 2014-18 |
| 4 | Solar Energy Research Institute for India and the United States (SERIIUS), Task PV3 | Co-PI | IUSSTF, DST | $\sim$ 625 | 2013-17 |
| 5 | Crystalline-silicon/perovskite tandem solar cell for high-efficiency photovoltaics | PI | Start-up, IISc | 36.0. | 2014-15 |

## Student Guidance

| | | In progress | Graduated |
|---|---|---|---|
| 1 | Ph.D. Students | 9 | 0 |
| 2 | M.Tech. & M. Sc (Engg.) | 0 | 3 |
| 3 | Post-Doctorate | 3 | 2 |