Dhruva Kulkarni

SUMMARY

I have two diverse areas of interest - Physics (Ph.D. expected-May 2017, MS 2016) and Computer Engineering(B.E.,2006). I am currently in the last stages of my Ph.D. in Physics at Clemson University and have previously worked as a Software Engineer for a startup for three years.

During my tenure at Clemson, I was involved in the setup and operation of the CUEBIT facitiliy (AIP Conf. Proc. 2015) at Clemson University where I had access to an Electron Beam Ion Trap/Source (EBIT) that produces highly charged ions which are usually found only in stellar environments. Studying the effects of these ions on terrestrial materials formed the bulk of my Ph.D. work.

We developed a new technique involving specially constructed MOS devices to measure below-surface damage caused by ion implantation using a shift in the flatband voltage and thus calculated the charge-state dependence of stopping power. Our results showed that the existing theory was not sufficient to explain the new findings, and we have shown that this is still an open problem. (JMR 2015, IEEE 2015)

I also had the opportunity to work on a DARPA LoCo project (advanced to phase II) whose aim was low temperature thin film growth. Our part in this project was to promote selected desorption of reactant co-products at surfaces using highly charged ions instead of the usual heating..

On the applied-physics side of things, these ions are still only found in highly-controlled ultra-high-vacuum (UHV) conditions, and a major breakthrough in transport technology is necessary in making this powerful tool accessible to industry. A part of of my Ph.D. work concentrated on a proposed solution to this problem (NIMB 2016).

I also had access to a singly charged ion beamline used for surface science studies. Using this system, I was able to study hyperthermal ion scattering and modeled the data by modifying and extending a home-built simulation code. Using an Auger Electron Spectrometer, I also performed depth-profiling studies for Savannah River National Laboratories (SRNL) on specially treated steel for hydrogen-isotope and nuclear waste storage.

Details regarding my research as a graduate student, publications and conference presentations can be found on the website of my research group: http://sosolik.people.clemson.edu/index.html and on my personal webpage: http://dkulkar.people.clemson.edu

On the computer engineering aspect: Before I made the switch to Physics from Computer Engineering, I was part of a start-up (Nevis Networks www.nevisnetworks.com) where I was employed as a software engineer. There I was able to, as part of the Tools team, get my hands on a proprietary multi-core hyper-threaded network processor (that was a nice challenge to program) and use it to develop an industry-standard network traffic generator to supply high volumes of stateful test traffic for network security products. The end-to-end development and high performance needs made for an exciting time for me at Nevis. I was also an intern at Nevis during the senior year of my Bachelor's degree in Computer Engineering from Pune University, Pune, India.

Apart from my interests in experimental physics, I am interested in computer networking, embedded systems programming and I enjoy programming tasks that are challenging with respect to time and space constraints, have a large use-case and require creative thinking.

PUBLICATIONS

Published papers:

1. D.D. Kulkarni, L.A.M. Lyle, C.E. Sosolik, "Ion transport through macrocapillaries - oscillations due to charge patch formation", *Nucl. Instrum. and Meth. B,* **382** 54 (2016)
2. D.D. Kulkarni*, R.E. Shyam*, D.A. Field, E.S. Srinadhu, J.E. Harriss, W.R. Harrell, C.E. Sosolik "Encapsulating Ion-Solid Interactions in Metal-Oxide-Semiconductor (MOS) Devices", *IEEE Trans. Nucl. Sci.* **62** 3346 (2015)
3. D.D. Kulkarni, R.E. Shyam, D.B. Cutshall, D.A. Field, J.E. Harriss, W.R. Harrell, C.E. Sosolik, "Tracking subsurface ion radiation damage with metal–oxide–semiconductor device encapsulation", *J. Mater. Res.* **30** 1413 (2015)
4. R.E. Shyam, D.D. Kulkarni, D.A. Field, E.S. Srinadhu, D.B. Cutshall, W.R. Harrell, J.E. Harriss, C.E. Sosolik, "First multicharged ion irradiation results from the CUEBIT facility at Clemson University", *AIP Conf. Proc.***1640** 129 (2015)

Technical Reports:

1. C.E. Sosolik, "Final Report: Multicharged Ion Promoted Desorption (MIPD) of Reaction Co-Products", Report for DARPA LoCo (W911NF-13-1-0042)

Manuscripts in preparation:

1. Heavier-than-target surface scattering (expected 2016)
2. Space charge effects on extracted ion beams from the CUEBIT (expected 2016)
3. Highly charged ion radiation damage on PC targets (expected 2016)
4. Highly charged ion induced defect assisted nanofeature growth on Cu_3Si (expected 2016)
5. CUEBIT – Clemson University Electron Beam Ion Trap (expected 2016)

PRESENTATIONS

1. "Modeling Heavy Atom Scattering" American Vacuum Society – International Symposium and Exhibition 2012
2. "Measuring charge dependent stopping powers at low kinetic energy using MOS devices" – Dynamics, Interactions and Electronic Transitions at Surfaces (DIET) 2014
3. "Measuring Potential Energy Dissipation using MOS devices irradiated with Multiply Charged Ions (MCIs)" – Southeastern Section of the American Physical Society 2014
4. "Ion Beam Labs at Clemson University – Recent Experiments" – Symposium for Introduction to Research in Physics and Astronomy, 2014
5. "Heavier-than-target surface scattering" – Southeastern Section of the American Physical Society 2015
6. "Transporting Ions Flexibly" - Symposium for Introduction to Research in Physics and Astronomy, 2015
7. "Hyperthermal Ion Induced Hot Carrier Excitations in a Metal Probed using Schottky Diodes" - American Vacuum Society – International Symposium and Exhibition 2016