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Nanoscience and nanofabrication at Argonne National Laboratory: The art of making small¹

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Over a decade ago the Department of Energy started the design, and construction of five Nanoscale Science Research Centers at different national laboratories with the objective to provide research opportunities in Nanoscience for the scientific community worldwide. The Center for Nanoscale Materials (CNM) at Argonne National Laboratory was constructed in 2006, and opened its doors to the user community in 2007. Currently the CNM hosts over 400 user proposals a year. There are six research groups at the CNM that do work in nanophotonics, electronic and magnetic materials and devices, nanobio interfaces, nanofabrication and devices, x-ray nanoscale microscopy and theory and modeling. I work in the Nanofabrication and Devices group and my research career has covered the use of x-rays, electrons and ions in the pursuit of making the smaller and smaller structures and devices. At the CNM I have been able to push the limits of electron beam lithography, and expand the use of ion beams to large area nanofabrication. Some of our accomplishments include determining liquid-polymer interactions as a function of temperature, redefining proximity effect correction at the nanoscale (NanoPEC), measuring to less than 0.5% error the backscatter range for 100 KV electron beams and finding that the range is a function of the density of the substrate, fabrication of plasmonic slit waveguides, and using ions to create complex three dimensional structures for use in fluidics. None of these accomplishments are possible without detailed understanding of the physics and chemistry mechanisms involved during fabrication. This requires extensive theory and simulation work to validate our experimental results. The fruit of our work then is a full understanding of “why” we use certain processes for nanofabrication and not just a simple set of process recipes. A summary of all these activities will be discussed at the presentation.

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