A dedicated ion-beam sputter (IBS) system was acquired and installed at the Northwestern University Center for Atom-Probe Tomography (NUCAPT) with $30,000.00 financial support from the ISEN program. The IBS system deposits high-quality, dense, and comparatively pure thin films with thicknesses between several to several hundred nanometer thickness on any given substrate material, in a high-vacuum chamber. NUCAPT currently provides the following target materials: Ni, Cr, Pt; additionally users are welcome to use their own target materials.

At NUCAPT, the IBS system was predominantly used for depositing protective buffer layers, e.g. Ni with 30-50 nm thickness, on specimen surfaces to enable the preparation of tip specimens by focused-ion beam (FIB) milling for atom-probe tomographic analysis. The thin-film buffer layer minimizes irradiation damage to the specimen, and also serves as a fiducial marker for the original specimen’s surface. Beyond applications for assisting tip preparation for the LEAP tomograph, the ion-beam sputter system can be used wherever a high-quality controlled thin-film deposition for single or multilayer structures is needed.

In the year since the installation in September 2009, the IBS system has been used for 101 hours “gun time” for 81 individual thin-film deposition sessions. 63% of the usage time was for the energy-related research projects listed below. Ten users from four different research groups at Northwestern and four cooperative projects (two internationally) with other institutions have used the sputter deposition system during the first year of its operation.

Research applications of the IBS system for energy-related projects at Northwestern have been diverse: (1) Thermal barrier coatings on Ni-base superalloys which are essential for prolonged lifetime of land-based and aerospace gas turbine blades. This work has been carried out partially with a research booster award from ISEN. (2) Stress-corrosion cracking in Ni-base superalloys limiting component lifetime in nuclear reactors. IBS thin-film deposition was integral for the preparation of LEAP tomography specimens from inside an oxidized crack wall. The results did reveal a tunnel-like propagation of the oxide formation from the surface and allowed for determining the composition of several distinct oxide phases formed in the process. (3) Dopant atom concentrations and distributions in gold-catalyst grown Si-based nanowires which are promising candidates for small-scale nanoelectronics. (4) LEAP characterization of isotopically pure silicon multilayer structures. Isotopically pure Si has different physical properties than the natural isotope mix currently used in microelectronics, thereby offering the potential for improved performance of electronic components. This work has recently been accepted for publication in *Applied Physics Letters*. (5) Controlling charge recombination processes for high-efficiency solid-state lighting in “giant” nanocrystal quantum dots for which defect sites on the surface limit performance. “Giant” nanocrystal quantum dots with a core-shell structure of a ~3.3 nm diameter CdSe core, and a Cds shell with ~6 nm thickness improve the quantum efficiency up to ~80% as compared to 5% for bare CdSe quantum dots. IBS deposition is instrumental for preparing specimens for the local electrode atom probe tomography to structurally and compositionally characterize these quantum dots, the interfacial sharpness, and chemical gradients across the interfaces in these core-shell structures.

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