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AA-05. The High-Resolution Synchrotron X-ray Scanning Tunneling Microscope (SXSTM) for Chemical Electronic and Magnetic Imaging.

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One fundamental challenge in surface science that inhibits our understanding of nano-scale surface phenomena is our inability to collect pertinent, localized information about the chemical electronic and magnetic nature of a sample surface with sub-nanometer to molecular-scale resolution. Variants of the scanning probe microscope can provide detailed information about the atomic and electronic surface structure, but do not easily yield direct chemical information. Advanced x-ray microscopy techniques (photoemission electron microscopy) yield chemical information, but typically, do not provide spatial resolutions beyond a few tens of nanometers. Currently, we are developing a new in-situ synchrotron x-ray scanning tunneling microscope (SXSTM) at Argonne National Laboratory's Advanced Photon Source. The high-resolution, lense-less microscopy technique takes full advantage of the chemical, electronic and magnetic sensitivities that synchrotron x-ray radiation offers and combines this with the sub-nanometer spatial resolution of the scanning tunneling microscope. Utilizing this technique, we have demonstrated the capability to image nano-scale materials with chemical, electronic, and magnetic contrast. [1,2] Recent studies also indicate the plausibility of localized sub-nanometer scale x-ray magnetic circular dichroism (XMCD) measurements utilizing SXSTM instrumentation. The potential to perform sub-nanometer scale XMCD measurements at the surface would allow one to study the impact of local magnetic structure (atomic-scale defects, domain walls propagation) on real-world, nanotechnology-based material systems. The SXSTM technique could conceivably provide new scientific insights into the physical behavior of the smallest building blocks of next-generation spin-based electronic devices. This work was funded by the Office of Science Early Career Research Program through the Division of Scientific User Facilities, Office of Basic Energy Sciences of the U.S. Department of Energy through Grant SC70705. Work at the Advanced Photon Source, the Center for Nanoscale Materials, and the Electron Microscopy Center was supported by the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under contract DE-AC02-06CH11357.

[1] M.L. Cummings, T.Y. Chien, C. Preissner, V. Madhavan, D. Diesing, M. Bode, J.W. Freeland, V. Rose, Ultramicroscopy 112, 22 (2012). [2] Volker Rose, Kangkang Wang, TeYu Chien, Jon Hiller, Daniel Rosenmann, John W. Freeland, Curt Preissner, Saw-Wai Hla, Adv. Funct. Mater. 23, 2646 (2013).