A Microfocus Beamline for Angle-Resolved Photoemission at the SRC

T. Miller
Department of Physics and Frederick Seitz Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, IL 61801

Angle-resolved photoemission spectroscopy has proven to be an excellent tool for the study of the electronic structure of bulk solids, surfaces, interfaces, and thin films. A limitation is imposed by the size of the illuminated spot on the sample (typically some fraction of a millimeter); oftentimes surfaces of samples that are homogenous over this area are not available. For example, cleaving may naturally expose different crystal planes, and the area covered by the incident photon beam may then consist of a collection of small domains with different photoemission spectra. The result is an average which obscures the true nature of the material. To address this problem, as well as provide additional functionality to the technique, a proposal entitled “Development of a Microfocus Photoemission Beamline for Materials Research and Education” has been submitted to the National Science Foundation. The Principal Investigator (PI) is Tai Chiang of the University of Illinois Urbana-Champaign (UIUC), and the project is a collaboration between the UIUC (also with T. Miller, co-PI), SRC (Hartmut Höchst, co-PI and SRC liaison), Iowa State University (Adam Kaminski, co-PI), and the University of Wisconsin (Franco Cerrina, co-PI). As proposed, a microfocus angle-resolved photoemission facility would be implemented by modifying the “B” branch line of the PGM beamline and one of the SRC Scienta endstations. A diverting mirror bypasses the existing refocussing mirror, directing the light towards a final Schwarzchild optic. The final optic provides a 50:1 demagnified image at the sample of the PGM-B exit slit and horizontal aperture, so that with a 50 micron slit and aperture, a 1 micron final focus is produced. The original PGM focus would be restored at the same point on the sample as the microfocus by removing the diverting and Schwarzchild mirrors. The Schwarzchild involves 2 normal-incidence reflections, giving continuous coverage over a low-energy (~8-20 eV) range; multilayer coatings can be used to obtain performance at selected higher photon energies, but with limited bandwidths. For this reason multiple optics, optimized at different photon energies (e.g. 50 and 100 eV), would be fabricated and made to be selectable. In this talk, a variety of applications of this beamline will be outlined and possible options in the design and construction will be discussed.