Meeting Report:

2009 SSRL School on X-ray Spectroscopy Techniques in Environmental and Materials Sciences: Theory and Application

June 2-5, 2009, SSRL

Group photo of the attendees at the SSRL School on X-ray Spectropscopy Techniques in Environmental and Materials Sciences: Theory and Application held June 2-5, 2009 at the Stanford Synchrotron Radiation Lightsource.

More than 50 students, post-docs, and career scientists from US national laboratories, academic institutions and the international user community participated in this 4-day school that delved deeply into theoretical and practical aspects of synchrotron x-ray spectroscopy. The fourth annual school on synchrotron techniques in environmental and materials sciences, organized by the Stanford Synchrotron Radiation Lightsource (SSRL) at the SLAC National Accelerator Laboratory, was designed to introduce new and prospective users to theoretical underpinnings and capabilities of the techniques, data collection procedures, and data analysis approaches. More advanced topics, particularly in data analysis, were also discussed to reinforce and clarify important concepts that are fundamental to data interpretation. Although the school

focused principally on applications in environmental and materials sciences, diverse and cross-cutting disciplinary backgrounds were represented; from environmental remediation science and geochemistry, to heterogeneous catalysis and bioinorganic chemistry, to materials sciences and applied physics.

The strong turnout for the school reflects the central role of modern synchrotron radiation (SR)-based X-ray absorption spectroscopy (XAS) techniques for studying the molecular-scale physical and electronic structure that govern the chemical properties of complex materials and molecular complexes. The high collimation, intensity, and tunability of synchrotron radiation allow the investigation of a wide range of materials, including interfaces, nanoparticles, amorphous materials, hydrated and disordered biogenic minerals, soils, and dissolved species.

The first day of the school featured classroom lectures. Seven speakers presented lectures, starting with a deep introduction to EXAFS (Corwin Booth, LBNL)

and XANES theory (Ritmukta Sarangi, SSRL), followed by talks on x-ray sources and optics (Apurva Mehta, SSRL), and practical aspects of data acquisition (John Bargar, SSRL). Afternoon talks focused on cross-cutting themes and advanced spectroscopic techniques, including Resonant Inelastic X-ray Scattering and X-ray Emission (Uwe Bergmann, SSRL), polarized and grazing-incidence XAS (Glenn Waychunas, LBNL), and X-ray microprobe techniques (Sam Webb, SSRL). We thank the lecturers for their generous efforts.

The second day of the school involved "hands-on-the-experiment" morning and afternoon training sessions at three of SSRL's EXAFS beam lines (BL4-1, BL4-3, and BL11-2) and at the hard x-ray microprobe (BL 2-3). Practical sessions were heavily attended. Participants overwhelmingly commented that the sessions were very useful. The third and fourth days of the school were devoted to hands-on data processing and analysis teaching/working sessions, expanded from one day in previous years in response to participant requests. Topics covered included: A detailed introduction to the SIXPACK data processing software package, data inspection, rejection, averaging, and dead-time correction, background subtraction, principal component analysis, linear combination fitting, FEFF fitting, examples of fitting environmental and materials samples, and a wrap-up session.

Another X-ray spectroscopy school at SSRL dedicated to x-ray scattering techniques in environmental and materials sciences is being planned for May/June 2011. Organizers thank the DoE, Office of Basic Energy Sciences, Office of Biological and Environmental Research, and NIH National Center for Research Resources for supporting this multidisciplinary school.

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SSRL