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PREFACE

The functionalities of materials and devices have their origin typically in structural properties at the molecular scale and mesoscale, and may extend to the macroscale. Basic understanding of these interrelations requires detailed analysis of the structural properties of materials. There has been tremendous progress in the development of materials characterization methods.

This volume contains papers presented at Symposium V, “In Situ Transmission Electron Microscopy and Spectroscopy,” and Symposium W, “Diagnostics and Characterization of Energy Materials with Synchrotron Neutron Radiation,” both held April 5-9 at the 2010 MRS Spring Meeting in San Francisco, California. The purpose of these two symposia was to bring together a broad coalition of scientists from the fields that engaged in the use of electron microscopy and spectroscopy, neutrons, and synchrotron x-ray methods to probe into the structure and properties of materials. The symposia provided an ideal platform for discussing state-of-art techniques based on electrons, photons and neutrons for exploring the structure and property relationship of energy materials and nanomaterials.

One of the major highlights of these two symposia is the potential developments on the next generation in-situ and ex-situ techniques for materials science in general. There is a broad interest in understanding chemical transformations on surfaces, in materials interfaces, and in many areas of nanoscience, including catalysis, energy materials and environmental science. Advanced tools to obtain site-specific information in realistic reaction environments are needed to enable a new level of understanding about the behavior of advanced materials under relevant operating conditions. Advances in spectroscopy and microscopy, as well as new combinations of in-situ and ex-situ methods, enables real time measurements using a variety of synchrotron and laboratory-based capabilities. In particular, the utilization of novel ambient pressure x-ray, electron and vibration spectroscopy techniques to understand oxidation and catalytic reactions on surfaces in energy and environmental science studies plays a crucial role in the advancement of science and technology. New developments in electron microscopy, including aberration-corrected microscopes coupled with environmental cells, allows unique in-situ experiments to study structure/property & stimuli/response relationships, and related dynamic processes at or near atomic/molecular level. Finally, neutron tomography and radiography allow us to look internally at devices and systems under operation.

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