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Synchrotron Consortia for Catalysis and Electrocatalysis Research

The year 2020 marks the fifteenth anniversary of the Synchrotron Catalysis Consortium (SCC), the first-of-its-kind organization of synchrotron users coming from universities, national laboratories, and industrial companies, funded (by a grant from the United States Department of Energy) to develop and provide dedicated infrastructure and research support to visiting scientists working in the fields of catalysis and electrocatalysis. Since its inception in 2005 and to this day, the SCC has been helping to attract researchers to NSLS and NSLS-II facilities and sharing its model with other synchrotron facilities and user communities worldwide. The SCC model has three main thrusts: (1) providing specialized sample-handling capabilities for in situ and operando experiments; (2) providing hands-on beamline experimental support and expert assistance with data analysis and modeling; and (3) outreach and training, through workshops and short courses on synchrotron methods and their applications to catalysis. Since 2005, many advances made in hard, tender, and soft X-ray synchrotron capabilities (including, but not limited to, high energy resolution absorption and emission spectroscopies, X-ray tomography using micro- and nanoprobes, and high throughput data acquisition methods), as well as new methods of data analysis and modeling, such as those assisted by machine learning approaches [1], contributed to the development of new applications to catalysis science and thus established new opportunities for the synchrotron user communities [2]. In addition, a surge in the development of multi-modal approaches to catalysis research, in which X-ray absorption and emission spectroscopies studies of working catalysts are combined with complementary measurements of X-ray diffraction, vibrational spectroscopies (ultraviolet-visible light, infrared and Raman spectroscopies), X-ray photoelectron spectroscopy, electron microscopy, as well as computational modeling, required the development of new supporting infrastructures, new kinds of user support, and new types of resources [3]. As a result, catalysis and electrocatalysis communities worldwide either upgraded their models or developed new models of such research support, varying from combining multiple analytical systems at the same beamline to creating a central facility, or hub, where the members are supported at various synchrotron beamlines, to a model in which advanced capabilities at different beamlines are exploited in collaboration with the consortium stuff.

The articles in this issue present the status of six synchrotron consortia worldwide.

They include: the Synchrotron Catalysis Consortium (SCC) and the recently established Defense Synchrotron Consortium (DSC), both at Brookhaven National Laboratory, USA; the Consortium for Operando and Advanced Catalysis Characterization via Electronic Spectroscopy and Structure (CO-ACCESS) at SLAC National Accelerator Laboratory, USA; the Catalysis hub at Harwell, UK; the ROCK beamline consortium at SOLEIL Synchrotron, France; and the BL36XU beamline consortium at SPring-8, Japan. These contributions summarize the latest developments in the catalysis research infrastructure and provide overviews of their user communities, the scientific themes, and the research methodologies the consortia developed for addressing research needs. Each group provides representative examples from recent research at their consortia, showcasing both the need for advanced synchrotron radiation methods and the advantage of the consortium approach for effectively supporting catalysis users. ■

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