

## Novel Tools and Techniques of Today and Tomorrow: For Studying Catalysis and Energy Problems

Zahid Hussain

Division Deputy for Scientific Support, Advanced Light Source, Lawrence Berkeley National Laboratory

The quest for renewable energy requires us to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels. The ever-increasing demand to diversify the energy portfolio and to minimize environmental impact while supplying global energy needs, has intensified the urgency for developing alternative energy sources and carriers. Significant research efforts are under way and will continue in a broad range of materials synthesis, use-inspired and fundamental science with the use of light sources such as synchrotron and free electron lasers. Energy-related materials research faces urgent challenges today. We need to go beyond the Edisonian hit and trial approach to more systematic research with the use of advanced tools applicable under realistic in-situ and in-operando conditions capable of exploring electronic and atomic structure of catalysts and energy relevant materials. Through various scientific examples, I will explain the current state-of-the art and future directions in the aforementioned areas of research.