

Ultrafast X-ray Studies in Catalysis: Progress, Challenges, and Perspectives

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Fundamental events in catalysis take place on ultrafast time scale comparable to vibrational motions of the molecules or materials, whereas the macroscopic reaction rates in catalysis are on the time scales up to hours. The ultrafast pump-probe approach using the pulsed x-rays to examine the transient structures allows us for the first time to look into the molecular movies during catalysis on the time scales of the chemical bond breakage and formation. A few examples of homogeneous photocatalysis mimics will be given where transient molecular structures of transition metal complexes are directly obtained. The challenges arise for studying those catalytic reactions that are not photoactivated and those with low turnover numbers. A few ongoing and proposed approaches will be discussed including new ultrafast non-photo trigger sources, and new approaches in data analysis extracting structural information from differential XAS.

This work is partially supported by the LDRD fund, by the Division of Chemical Sciences, Geosciences, and Biosciences, Office of Basic Energy Sciences, U. S. Department of Energy under contracts DE-AC02-06CH11357. Use of the Advanced Photon Source was supported by the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357.