Operando XAS study on heterogeneous catalysts and application of high energy resolution fluorescence detection

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In this talk, I would like to show examples of application of X-ray absorption spectroscopy to various materials including catalytic converters (three-way catalysts), single atom catalysts, and an attempt to obtain range-extended EXAFS spectra and high energy resolution XANES spectra of heavy elements using high energy resolution fluorescence detection techniques.

Catalytic converters, a device to convert harmful gases such as carbon monoxide, unburnt hydrocarbon, and nitrogen oxides in automobile exhaust gases into carbon dioxide, water and nitrogen, have been developed and utilized for protecting air pollution. The technology is almost mature, but its working and/or deterioration mechanism are still unclear. Operando XAS study on model three-way catalysts of Rh/Al_2O_3, Pd/Al_2O_3, and Pd/CeO_2 are discussed.

Single atom catalyst (SAC) is a rediscovered group of catalysts characterized by the singly adsorbed/supported/incorporated species in heterogenous materials. X-ray spectroscopy is a suitable characterization tool for SAC. Operando study on reaction mechanism of CO oxidation over Rh SAC is discussed.

High energy resolution fluorescence detection (HERFD) for X-ray is not a new, but spotlighted technique to gather fluorescence X-ray from a *single* fluorescence line based on the state-of-the-art intense X-ray source and sophisticated optics. Range-extended EXAFS measurement proposed by Dr. P. Glatzel is revisited and applied to a SAC. As recently well known, HERFD is also essentially effective for measurement of high energy resolution XANES (HR-XANES) spectra. Some recent data of HR-XANES of lanthanide complex oxides will be discussed.