FOXSI
Functional Oxide Surfaces and Interfaces

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Probing catalytic interfaces and materials by in situ spectroscopy combined with modulation excitation technique

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Abstract:

Catalysts and catalytic processes play pivotal roles in chemical industry and environmental protection. Their developments are, however, largely dependent on empirical approaches because of the high process complexity. This is particularly true for heterogeneous catalytic processes where reactions occur at solid surfaces and involved physicochemical processes are complex. Recent great advances in *in situ* and *operando* spectroscopic methodologies have enriched knowledge on catalytic active sites and reaction mechanisms under technically relevant conditions, which could not be gained by traditional UHV surface characterization techniques because of pressure and material gaps which often change the whole story of activation mechanisms.
In this presentation, some of the developments of *in situ/operando* vibrational spectroscopic techniques, namely, attenuated total reflection infrared spectroscopy (ATR-IRS) for solid-liquid interfaces, polarization-modulation infrared reflection-absorption spectroscopy (PM-IRRAS) for both gas-solid and solid-liquid interfaces, and space- and time-resolved DRIFT-Raman spectroscopy for gas-solid interfaces, are presented. Their detection sensitivity is boosted by employing a correlation technique, so-called modulation excitation spectroscopy (MES). MES also allows adding selectivity into the detection methods (e.g. seeing only 'active sites' without 'spectators') and studying reaction kinetics and pathways. Our current efforts to combine ME technique with X-ray diffraction and XAFS at synchrotron light facilities will also be discussed.

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