

Recovering High-Temperature EXAFS Despite Debye-Waller Damping by Modulation-Excitation XAS

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Extended X-ray absorption fine structure (EXAFS) analysis at elevated temperature is limited by Debye–Waller damping, which suppresses high-k oscillations and narrows the usable fitting range. In this presentation I will discuss the use of modulation-excitation X-ray absorption spectroscopy (ME-XAS) combined with phase-sensitive detection (PSD) to recover analyzable EXAFS from PtFe/Al₂O₃ under alternating H₂/O₂ gas atmosphere.

Application of MES-PSD allows reversible redox dynamics to be isolated while suppressing the spectral noise at both the Pt-LIII and Fe-K edges. Even at temperatures up to 700 °C, the reconstructed spectra retain high-k oscillations. These oscillations are otherwise buried by the noise in the raw data, yielding a 2–3-fold improvement in signal-to-noise ratio. This workflow extends operando EXAFS into temperature regimes where conventional measurements are often restricted to X-ray absorption near-edge structure (XANES) analysis.