Ultrasensitive Probing of Local Electronic Structure in the Soft X-ray Regime

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Superconducting transition edge sensor (TES) technology presents a unique opportunity to build novel detectors with greatly increased sensitivity in the soft x-ray regime while maintaining excellent energy resolution. SLAC and Stanford in collaboration with N IST have commissioned a new generation soft x-ray superconducting TES spectrometer at SSRL with a scientific motivation to probe the local electronic structure of ultra-low concentration sites in biology, chemistry, and materials, currently inaccessible in the soft x-ray regime due to the limited sensitivity of existing technology. We will present an introduction to our recently commissioned TES spectrometer at Stanford Synchrotron Radiation Laboratory and its premise to explore new paradigms in soft x-ray spectroscopy, achieving sensitivity of sub-mMol concentrations in aqueous/organic solvents, sub-percent sensitivity for monolayer films immersed in a solvent, solid matrix, or high-pressure gas, and sensitivity to concentrations <1019/cm3 for defects and dopants in condensed phase samples. We will show early results on active metal centers of bio-enzymes, intermediates relevant to chemical catalysis, interfacial properties in energy materials, and nature of ultralow concentration defects and dopants in semiconductors.