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Inner-shell electron spectroscopy using hard x rays[1] STEPHEN SOUTHWORTH, DIMITRIS KOULENTIANOS, GILLES DOUMY, ANNE MARIE MARCH, CHRIS OTOLSKI, KAI LI, PHAY HO, DON WALKO, LINDA YOUNG, Argonne Natl Lab — Photoelectron and Auger electron spectroscopies excited by tunable synchrotron radiation are sensitive to electronic structure, photoionization dynamics, and core-hole decay mechanisms. These topics attract the interest of theorists who seek to explain and model the observed phenomena. The intense, polarized, tunable, narrow bandwidth x rays produced by beamlines at the Advanced Photon Source (APS) are ideal for Hard X-ray Photoelectron Spectroscopy (HAXPES). We are developing a HAXPES instrument for experiments at the APS using a high-resolution, high-collection-efficiency electron analyzer. The first experiments will explore two topics. The first is to characterize inner-shell resonance and threshold effects by tuning the x-ray energy across K-edges of atoms and small molecules. Our second goal is to characterize double-core-hole states in molecules in which hollow core shells are produced by single-photon absorption and generated by electron correlation. The electron spectra will record states with one core-ionized electron and one core-excited electron [1]. [1] D. Koulentianos *et al.*, J. Chem. Phys. **149 134313 (2018).**

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