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Transuranic Photoemission Using a Unique Light Source[1]

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There has been a remarkable advance in the understanding of electronic structure for complex materials in recent years. Much of this advance in understanding has been realized through advanced spectroscopy capabilities available at public synchrotron facilities. While the vast majority of materials can take advantage of facilities at public synchrotrons, transuranic materials are excluded from these facilities when multiple containment barriers are incompatible with the chosen spectroscopy. We have developed an advanced spectroscopy capability at Los Alamos for photoemission on transuranic materials including Pu. Using several different variants of photoemission we have explored a wide range of Pu materials which has lead to a significant improvement in our understanding of transuranic electronic structure. Examples of these successes will be given along with details of the unique facility. Using the unique capabilities of our transuranic photoemission system we exploit opportunities in angle-resolved photoemission (ARPES) providing insight into the details of both the energy and crystal momentum for a material. Additional information is obtained using tunable photons which may be used to isolate the 5f electron contribution to the valence electronic structure. Between ARPES and tunable photoemission, one may construct a fairly detailed picture of the bonding and hybridization for transuranic materials. By adding temperature-dependent (10 - 350K) photoemission to the suite of tools, we may cross over phase transition boundaries as well as quantify electron-phonon coupling. We also have the capability for 1.5 and 3 KeV core-level spectroscopy using a monochromatized x-ray source. By combining the above photoemission tools with a variety of surface preparation capabilities including cleaving, laser ablation, and thermal desorption, we have a flexible and capable spectroscopy facility that provides unique insight into the electronic structure of transuranic materials.

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