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Soft X-Ray Photoelectron Spectroscopy of Bi-Metallic Interfacial Bonding
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Application of soft X-ray photoelectron spectroscopy (SXPS) to probe the bonding at epitaxial, bi-metallic interfaces with atomic-layer spatial selectivity is reported. The W(4f) sub 7/2 levels of interfacial tungsten atoms were measured for (1 x 1)Fe /W(110), (1 x 1)Ni/W(110), and (1 x 1) Pt/W(110). For clean W(110), the surface atoms exhibit a W(4f) sub 7/2 peak at --320 meV binding energy with respect to the bulk W(4f) sub 7/2 peak. Upon formation of the metallic overlayers, the interfacial W atoms contribute W(4f) sub 7/2 peaks at --225 meV (Fe/W), --140 meV (Ni /W), and +70 meV (Pt/W) with respect to the bulk W(4f) sub 7/2 peak. The systematic reduction in the binding energy difference between interfacial and bulk W atoms for iron, nickel, and platinum correlates with increasing heats of adsorption on W(110), as determined by temperature programmed desorption. This suggests that SXPS, in combination with first principles calculations and Born--Haber thermochemical cycle analyses, can be used as a non-destructive probe of bi-metallic interfacial bonding energies.

Descriptors: Iron | Thin films | Tungsten | Nickel | Platinum | Bimetals | X ray analysis | Soft X ray spectroscopy | Interfaces | Bonding