Formation of binary metallic alloys in the nanometer-thickness range studied by photoelectron spectroscopy

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Alloy formation by mixing of two ultra-thin metallic layers, Pd-Cu, Pd-Ag and Co-Ag, deposited onto an impenetrable Ru(0001) surface, has been studied as a function of temperature. Physical properties like alloy formation, 2-and 3-dimensional diffusion, segregation and desorption are investigated. The experimental evidence is based on photoelectron spectroscopy using synchrotron radiation for determination of valence band density of states, core-level binding energy shifts (CLSs) and surface CLS (SCLS), supplemented with low-energy electron diffraction measurements. For the Pd-Cu and Pd-Ag surface alloys, calculations of the CLSs and SCLSs based on first-principles techniques, including initial and final state effects, show good agreement with the experimental results [1].

As an example, it is demonstrated how high-resolution CLS and recording of valence spectra of a Ru(0001)/Ag(1 monolayer)/Pd(6 monolayer) sandwich are useful tools for detailed studies of the silver diffusion profile, the composition of the surface and the first few subsurface layers during heating of the nanosystem.

Reference


Direct Observation of 3 Dimensionality in Layered La₁₂Sr₁₈Mn₂O₇ Probed by Soft X-ray Angle Resolved Photoemission

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A bilayer perovskite compound La₁₂Sr₁₈Mn₂O₇ is a ferromagnetic metal (FM) below the metalinsulator transition temperature T_C ~ 120 K. Although the conductivity in the FM phase shows nanotisotropic behavior, it is thought that a finite out-of-plane hopping is not negligible along the perpendicular direction to the conducting layer judging from the temperature dependence of resistivity [1]. In order to clarify the origin of the prospective coherence along the out-of-plane direction, we have performed the soft X-ray angle-resolved photoemission (ARPES) with changing hν(k_z) from 562 eV to 612 eV as well as the Mn 2p-3d resonant ARPES to reveal the three-dimensional bulk Mn 3d band dispersions at BL25SU in SPring-8. The energy resolution was set to 100–200 meV. We have observed a clear band dispersion along the out-of-plane direction from the hν(k_z) dependence ARPES spectra. Our findings provide the conclusive evidence of the evolution of the 3 dimensionality due to the coherence along the out-of-plane direction in layered La₁₂Sr₁₈Mn₂O₇.

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Reference


Nano²hybrids compounds: Sample cases for electronic interaction at the carbon nanotube-metal interface

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Nano²hybrid materials combining carbon nanotubes and metal nanoparticles can be used as prototypes for understanding the nature of the metal-nanotube electronic interaction, in particular the Schottky barrier at the interface. We study how the deposition of Au, Ni or Ag modify the morphology and electronic structure of pristine and plasma-treated MWCNTs, using high-resolution X-ray photoelectron spectroscopy (XPS, Scienta300 spectrometer at LISE and beamline BW2 at Hasylab) and ultra-violet photoelectron spectroscopy (UPS, Flipper II at Hasylab). TEM images confirm that the oxygen plasma treatment improves the cluster dispersion and mediate the overlayer morphology. XPS results show the formation of chemical bond of Ni to C at the cluster-CNT interface. The decreasing binding energy of the C1s core levels with increasing Ni coverage suggests structural stress possibly caused by metal clusters diffusion through the CNTs “graphitic” wall. The apparent absence of binding energy shift in the Ni core level suggests electrical contact. By contrast, the observed shift on the Au 4f core level towards higher binding energies is a consequence of poor final-