

TWO-DIMENSIONAL BANDS OF RARE EARTH/GOLD SURFACE ALLOYS MEASURED WITH ARPES

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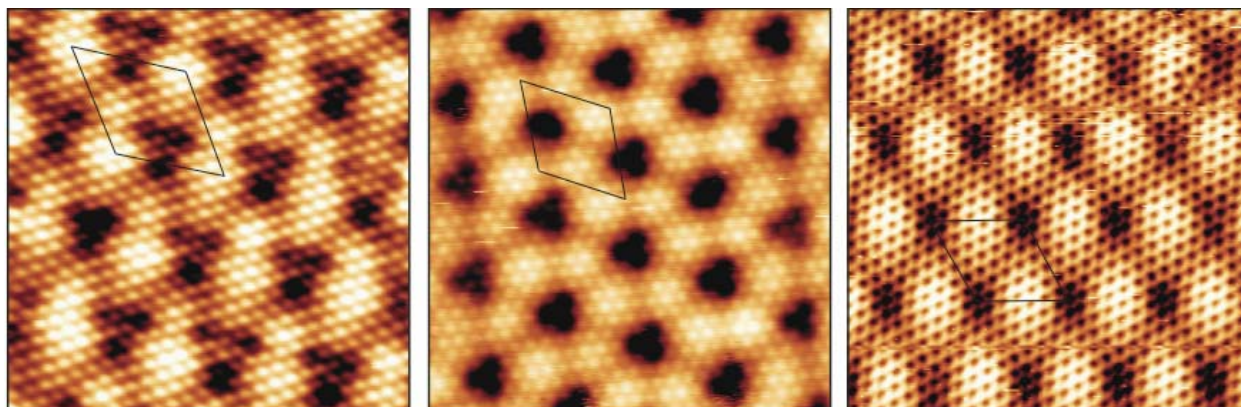
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The high temperature reactive deposition of rare earths (RE) on Au(111) has been thoroughly investigated combining STM and Angle Resolved Photoemission (ARPES) experiments. These materials are attractive for their possible exploitation in several fields as magnetic recording or hydrogen storage. We have focused on the reactive epitaxy of Gd, La, and Ce, where we have found that, under specific growth parameters, one can obtain RE/Au alloyed monolayers and bilayers with extraordinary crystalline perfection (see the Figure below). In the three metals the optimum surface structure, namely the one exhibiting homogeneous alloying over the whole surface, corresponds to the REAu₂ stoichiometry. Moreover, the lattice mismatch between the REAu₂ layers and the Au (1×1) substrate gives rise to long-range periodic Moiré patterns, whose lattice constant varies from 32±2 Å in La to 33±2 Å in Ce and to 38±2 Å in Gd (see the Figure below). The latter has been successfully tested as a growth template for magnetic Co nanodot arrays. By means of ARPES we have studied the two-dimensional band structure of such surface alloys. ARPES experiments have been carried out at the Synchrotron Radiation Center in Wisconsin. The band structure is similar in all cases with minor spectral intensity and energy variations. The results have been compared with band structure calculations performed by M. Verstraete and A. Rubio within the European Theoretical Spectroscopy Facility (ETSF) project. Theoretical calculations and experimental bands basically agree to explain the band dispersion, energy position, and orbital nature of the bands. Fine variations among the different RE compounds are explained in qualitative terms.



STM images (14.3×14.3 nm²) showing the atomic structure of the Gd-Au (left), the La-Au (center), and the Ce-Au (right) surface alloys grown by reactive epitaxy on Au(111). The Moiré pattern, whose unit cell is pictured in all cases, arises due to the mismatch with the Au(111) lattice underneath.