Poster

Growth and properties of fcc-FeCu alloy thin films

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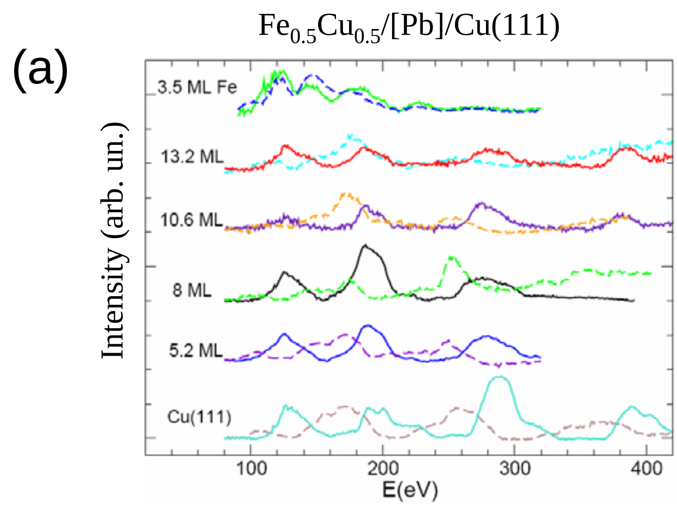
The magnetic properties of a given material are strongly related to its crystalline structure, because ferromagnetism is a prototypical collective electronic effect. Aspects so important as the magnetic moment per atom, the type of long-range order (ferro- or antiferromagnetic), or the coercive field, among others, are extremely sensitive to any modification of the interatomic distances or the chemical environment. The purpose of this work is to grow films of disordered Fe-Cu alloys of varying composition to control the structure and lattice parameter, to study the influence of these different structural properties on thin Fe films epitaxially grown onto them, and to check the influence of these procedure on the resulting magnetic properties.

The Fe-Cu templates are obtained codepositing simultaneously Fe and Cu onto a Cu(111) substrate, covered with a surfactant Pb layer to reduce the film roughness and at the same time to prevent the segregation of the two componentes by reducing the atom diffusion on the surface layer. LEED I-V curves measured on Fe_xCu_{1-x} films demonstrate that these mixtures retain the fcc structure for many monolayers and up to ~70% Fe concentration. Figure 1(a) presents (10) and (01) LEED IV curves demonstrating that the fcc structure is maintained throughout the growth of $Fe_{0.5}Cu_{0.5}$ films several nanometers thick. These measurements also reveal that the lattice parameter of the alloy films changes as a function of their composition (see Fig. 1(b)). These findings suggest a method to tailor the films' structure and to modify their magnetic properties.

The growth process has been analysed with the help of Monte Carlo simulations in continuous space, describing the atomic interactions by means of realistic empirical potentials. These simulations confirm the formation of atomic layers more compact than the Cu(111) substrate, with overall fcc structure although containing frequent stacking faults.

The magnetic properties of these films are studied in-situ by means of MOKE. Our results show that the fcc alloy films are magnetic, and the Fe atoms have magnetic moments similar or slightly larger than in its bulk bcc phase.



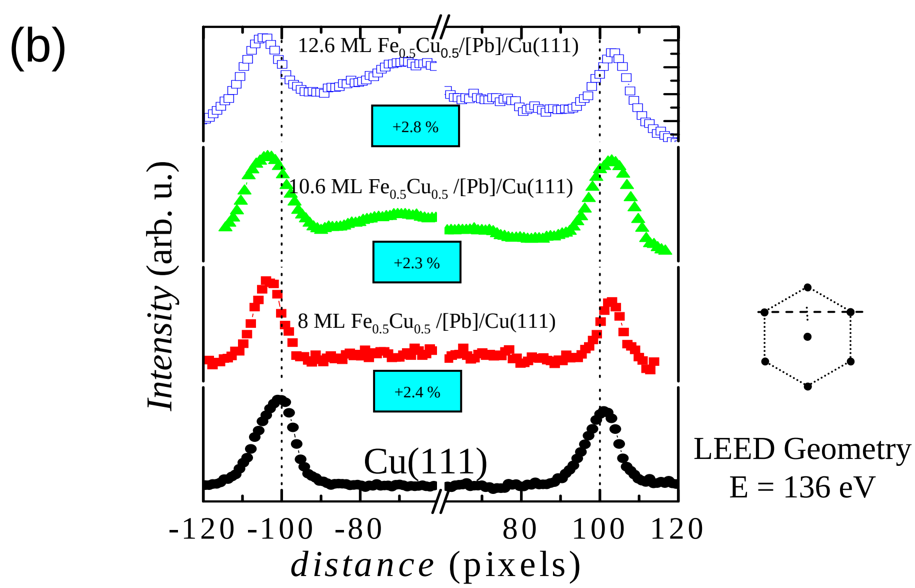


Figure 1. (a) LEED I-V curves show the fcc structure for different thicknesses of FeCu films. (b) In-plane reciprocal lattice scans through the diffracted beams of LEED patterns showing that the lattice parameter in the real space is compressed with respect to that of the Cu substrate.