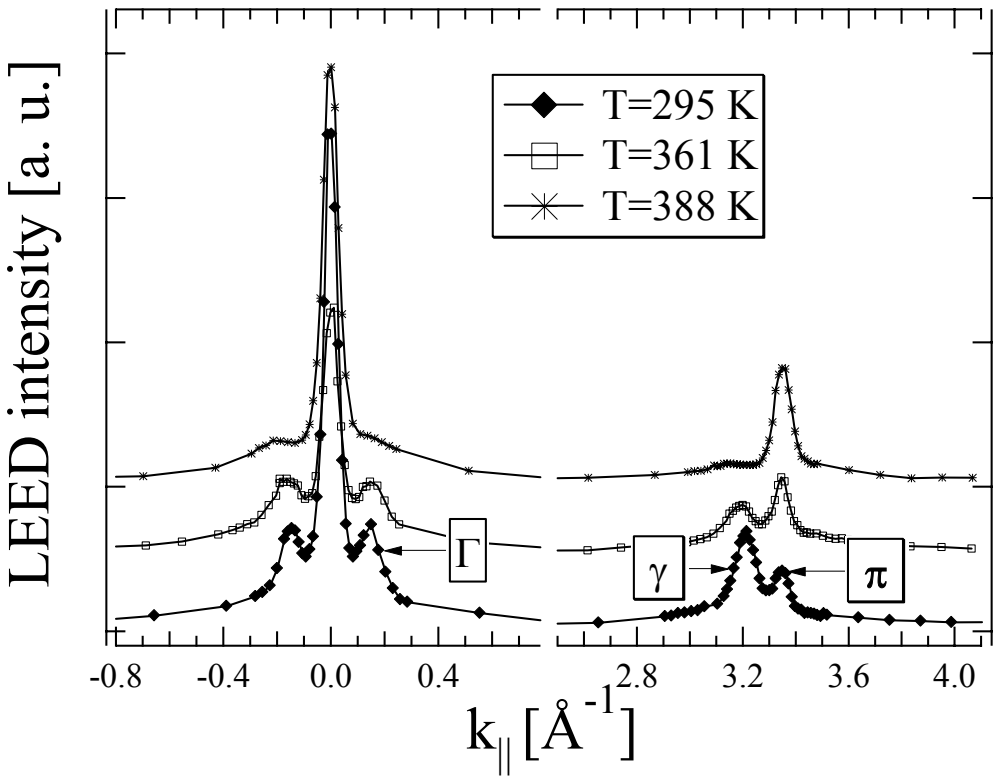
TEMPERATURE DRIVEN REVERSIBLE BREAKDOWN OF PSEUDOMORPHISM IN ULTRATHIN $Fe/Cu_3Au(001)$ FILMS.

F. Bisio[1,*], S. Terreni[1], G. Gonella[1], L. Floreano[2] and A. Morgante[2], M. Canepa[1] and L. Mattera[1],

[1]Unità INFM and CNR-IMEM, Dipartimento di Fisica, Via Dodecaneso 33, I-16146 Genova, Italy.
[2]Laboratorio TASC dell'Istituto Nazionale di Fisica della Materia, Trieste, Italy.

[*]e-mail: bisio@fisica.unige.it

We observe that ultrathin $Fe/Cu_3Au(001)$ films in the 6 ÷11 Å thickness range, beyond the thickness of pseudomorphism breakdown at room temperature, exhibit a temperature dependent structural phase transition at T_c=360 K. In the high temperature state the Fe film consists of a single fcc structural phase pseudomorphic to the substrate, while breakdown of pseudomorphism reversibly occurs by nucleation and enlargement of a partly relaxed face centred tetragonal (fct) phase, as the system is cooled below transition temperature.
The difference between substrate and overlayer thermal expansion coefficient is highlighted as the driving force for the observed transition, via an induced effective temperature dependence of the Fe overlayer strain energy. Implications on the magnetism of the film are also discussed. The investigation has been performed combining Helium diffraction (HeD) and Low Energy Electron Diffraction (LEED) techniques.



Temperature dependence of Low Energy Electron Diffraction azimuthal cuts measured along (100) crystallographic direction for an 8Å thick Fe/Cu_3Au(001) film. Peak labelled π represents substrate periodicity, while peaks labelled γ and Γ respectively represent diffraction from an Fe fct partly relaxed phase and from the coincidence pattern originated by the coexistence of γ and π phases. Notice the gradual disappearance of the pseudomorphism breaking γ phase with increasing sample temperature. The temperature dependent behaviour of the system is fully reversible.