ESRF	**Experiment title :** Bulk chemical order and surface morphology: Double step-single step phase transition on vicinal surfaces of the ordered alloy $Cu_{83}Pd_{17}$ (1 1 11).	**Experiment number:** **SI-154**
Beamline: **ID-3-BL 7**	**Date of experiment :** **from :20** march. **to:** 28 march. 96	**Date of Report :** **26/08/96**
Shifts : Allocated beam time: 18 Real time :18		*Received at ESRF:*

Names and affiliations of applicants :

BARBIER lUC, B. Salanon and S. Goapper SRSIM Bât 462
C.E. Saclay 91191 Gif-sur-Yvette cedex FRANCE

A. Loiseau, R Caudron ONERA Lab. de Phys. des solides OM. 92322
Châtillon-sous-Bagneux Cedex France.

J. ALvarez, S. Ferrer and X. Tolleres E.S.R.F. Grenoble France
All experimentalists.

Report:

Some ordered alloys undergo first order bulk disordering transition associated to the loss of the long distance chemical order. The $Cu_{83}Pd_{17}$ alloy (A_3B type) orders on the FCC lattice according to the $L1_2$ type structure and the temperature of the chemical disordering transition is T_c=778 K. Helium diflraction and STM observations of a vicinal of (100) surface namely $Cu_{83}Pd_{17}$ (1, 1,11) had shown the occurrence of a double step-single step phase transition at a temperature close to T_c. In the single step morphology the terrace length is L_0=5.5 atomic distances. The aim of the reported work was to investigate the relationship between the chemical order at and below the surface and its morphology. X-ray diffraction at grazing incidence is a unique tool for this purpose.

On a vicinal surface crystal truncation rods (CTRs) are perpendicular to the surface and cross bulk bragg peaks (see Fig. 1). For an ordered alloy different CTRS can be distinguished : fundamental (F) rods cross fundamental Bragg peaks and chemical rods cross peaks induced by the chemical superstructure. Our calculations show that some chemical rods (noted here M) are sensitive to the morphology of the surface and not to the chemical order. More precisely the rod intensity is governed by the difference of two successive terrace lengths δL_0 =L1-L2 (δL_0 =5 for double steps and O for single steps). Other chemical rods (χ) are only sensitive to the surface chemical order parameter (SCOP) (see Fig. 2). In the chemically ordered phase, the double step and single step morphologies present the same number and positions of chemical rods. The two surface structures can be only distinguish by the shape of M rods. Calculations also show that the intensity of χ rods allows to follow the evolution of the SCOP.

We have consequently measured the shape and intensities of the different kinds of rods (F, M, and χ) versus temperature below Tc. We have observed first that the shape of M rods is different from that of χ rods (see Fig. 3) confirming by X ray diffraction the existence of the double step surface morphology. Measurements of the intensity variation of M rods show a gradual evolution from the double step structure towards the single step structure : The terrace length asymmetry (versus T) of two adjacent terraces (L1-L2)/(Ll+L2) has been deduced. Simultaneous measurements of the thermal attenuation of χ rods were used to obtain the SCOP decay with T. From this measurement one finds that the terrace asymmetry is proportional to the SCOP in the temperature range 100 K-5 K below Tc.

Our experiment has thus successfully allowed to follow both the morphology and the chemical order of a vicinal surface. The simultaneous evolution of the terrace asymmetry and the surface chemical order parameter should give insights into the physics of the surface morphological transition.