ESRF	**Normal Incidence X-ray Standing Wave Experiment on an AlPdMn Quasicrystal**	**Experiment number:** S1362
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Report: The goals of this XRSW experiment on AlPdMn quasicrystals at ID32 beam line were defined in the following way: i) to look for evidences of this standing wave in the X ray absorption processes, ii) then to probe the dense plane structure inferred from the diffraction analysis of the bulk, iii) *its extension to the surface*, iv) by taking benefit from the chemical selectivity of this technique, precisions on the position of the different constituents in this layered structure will be searched for with a definite emphasis for the surface structure. This project could built because of the high bulk quality of the AlPdMn quasicrystal and because of our experience in the control of these surfaces. Indeed the bulk quality is good enough to make observable dynamical effects in X ray diffraction as evidenced by the observation of a Bormann effect. The propagation of coherent X rays in quasicrystal and the properties of photonic band gap at X ray energies induced by the quasicrystalline order is a fascinating question. Nowadays XRSW experiments on real quasicrystals are certainly among the best tools to probe this question and its relevance at the surface. *Experimental results:* At the beginning of the experiment, we could rapidly identify the Bragg peak we were looking for at energy: E= 2878eV. Despite the fact that we only had the drain current to look for the existence of a X ray standing wave in the bulk, this measure immediately showed an evidence for a coherent fraction when the beam energy was scanned across the Bragg peak by mean of the silicon monochromator.

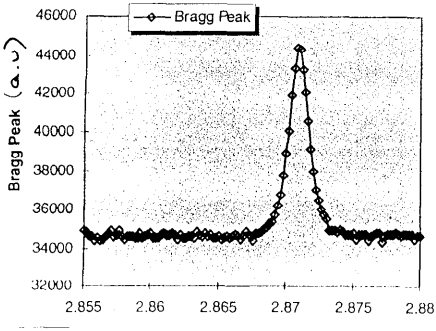
On the basis of this bulk reference, we then prepared the quasicrystal by a cycle of sputtering and annealing. Measurements of the selected Bragg peak during the surface preparation showed an irreversible transformation of the surface vicinity probed at this energy: the Bragg peak shifted by about 2eV although the peak shape retained a well defined Lorentz shape with a FWHM=0.8eV as shown in figure 1. As shown by the A12p core level and by Auger spectroscopy, the surface had to be cleaned again regularly.

In this configuration, using the Perkin Elmer analyzer, we could collect XPS core levels for each element A12p, Pd3d, Mn2p as the X ray energy was scanned across the Bragg peak. Three different surface states were probed: freshly sputtered surface, annealed surface at a temperature below 700K with an expected crystal AlPd in epitaxy on the quasicrystal and finally the quasicrystalline surface after annealing at a temperature of 850K.

For the three elements, the major result is that a coherent fraction is clearly observed only for the ordered quasicrystalline surface. This is shown on figure 2 for the Pd 3d core level. Sputtering systematically removed this effect and annealing at low temperature even for an extended period of time could not lead to the recovery of the apparent coherent fraction.

This is the first time that one is able to produce such a significant result. This shows that the ordered quasicrystalline surface coherently respond to the bulk established XRSW. We have started to analyze these results. First of all, we could see that a 1D Fibonnacci sequence can numerically produce a coherent XRSW signal. We are now entering a quantitative data analysis: XRSW signals from bulk atomic model have also been simulated. This quantitative analysis is in fact one motivation of a three month stay of one of us (G.C.) at the NIST Washington. This quantitative analysis will also greatly benefit from the one year visit of Roberto Colella as visiting professor at the CNRS Grenoble and at the ESRF. *Experimental problems:* The machine run smoothly apart from minor problems like voltage instability of the Perkin Elmer analyzer which made the data accumulation a bit tricky. It is however clear that a sample transfer system and a LEED would have allowed a quicker sample preparation prior to the synchrotron measurement with a significant economy of the allowed beam time.

Pic de Bragg (RX)



Pic 3d du Pd (XPS)