| ESRF | **Experiment title:** **Anomalous diffraction study at the Pd edge of the $F2_M$ AlPdMn modulated phase** | **Experiment number:** HS-174 |
|---|---|---|
| **Beamline:** ID1 | **Date of Experiment:** from: 10/10/97 to: 16/10/97 | **Date of Report:** *26/02198* |
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**Report:**

The $F2_M$-AlPdMn phase has a composition slightly different from the canonical icosahedral i-AlPdMn phase. High Resolution Electron Microscopy images showed that the structure is a multidomain structure with an overall icosahedral symmetry. Each domain has a size of the order 1 μm, with a cubic symmetry, but remains quasiperiodic'. The cubic axes are oriented along 4 of the 10 icosahedral 3-fold axes; the overall icosahedral symmetry is given by the 5 different orientation of the cube with respect to the icosahedron. A previous X-ray diffraction study showed that this phase transform at 720°C into the icosahedral phase'.

We used a spherical sample, 250μm in diameter, with an incoming beam monochromatised with a double Si3 11 monochromator. The beam size was 1* 1 $mm^2$ and we worked close to the Pd edge (24 keV). Several 2D X-ray diffraction maps of the $F2_M$-AlPdMn have been recorded. They present an extremely rich structure as shown on the figure. The same area recorded in the i-AlPdMn phase shows only one icosahedral Bragg reflection labelled 19/28 on the figure. In fact the $F2_M$ phase corresponds to a superstructure or- a commensurate modulation over the F2 phase[1, 2]. Both the F2 type reflections (labelled SF2) and the i-type reflections are surrounded by satellite reflections located at a position $\mathbf{q}_{S1}$, and their linear combination, in agreement with electron diffraction patterns. The wavevector $\mathbf{q}_{S1}$ lye along a direction parallel to the icosahedral 3-fold axes, and is commensurate with the i-AlPdMn reciprocal lattice, in agreement with the superstructure scheme. It corresponds to a wavelength of the modulation equal to 170A.

The integrated intensity of main i- and SF2 reflections and the corresponding Sl type satellites (a total of about 150 reflections) have been measured at two different energies bellow the Pd edge, corresponding to f' values equal to -6 and -2 electrons. A standard reflection was recorded each half hour to check for possible beam monitoring fluctuation.

For main reflections we observed a contrast variation similar to previous experiments[3]. The intensities of Sl satellites seem to follow the variations of the main reflections, but this cannot be definitely shown, for fluctuations of the integrated intensity of the check reflection was larger than 5%. A better beam stability is required to extract the partial Pd structure factor of the satellites.

Nevertheless interesting information could be extracted on each data set. In particular we could show that Sl satellites intensities can be reproduced by a simple sine phason waves distortion of the icosahedral phase, confirming previous results. The asymmetry of integrated satellites intensities located at $+\mathbf{q}_{S1}$ and $-\mathbf{q}_{S1}$ is in agreement with a superstructure indexing of these reflections. The behaviour of SF2 reflections is much more complicate, but depends strongly on the main i- Bragg peak intensity and also on their own perpendicular component.

Finally high resolution measurement of Bragg peak widths (measured in transverse geometry at low angle) gave significantly different correlation lengths for the three reflection types: 1.4μm for main i-reflections, 0.9μm for SF2 type and , 0.6μm for Sl type. This confirms the less ordered state of the Sl type modulation.

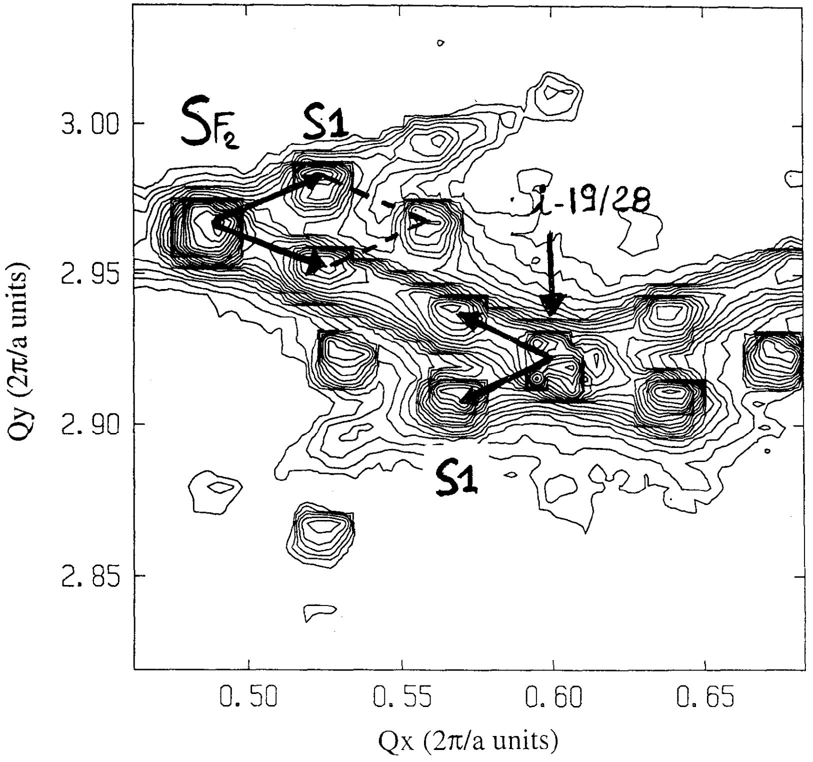


Figure: 2D isointensity map around the 19/28 main i- Bragg reflection . A large number of S 1 satellite reflection observed around he i- and SF2 type reflection.

**References:**


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3. M. de Boissieu, P. Stephens, M. Boudard et al., Phys. Rev. Lett., 1994, 72 3538