ESRF	Experiment title: Coherent Diffraction and Phason Disorder in theIcosahedral AlPdMn phase	Experiment number: HS716
Beamline: ID20	**Date of experiment:** from:15/11/98 to:2/12/98	**Date of report:** 25/02/99
Shifts: 18	**Local contact(s):** F. YAKHOU	*Received at ESRF:* 01 MAR. 1999

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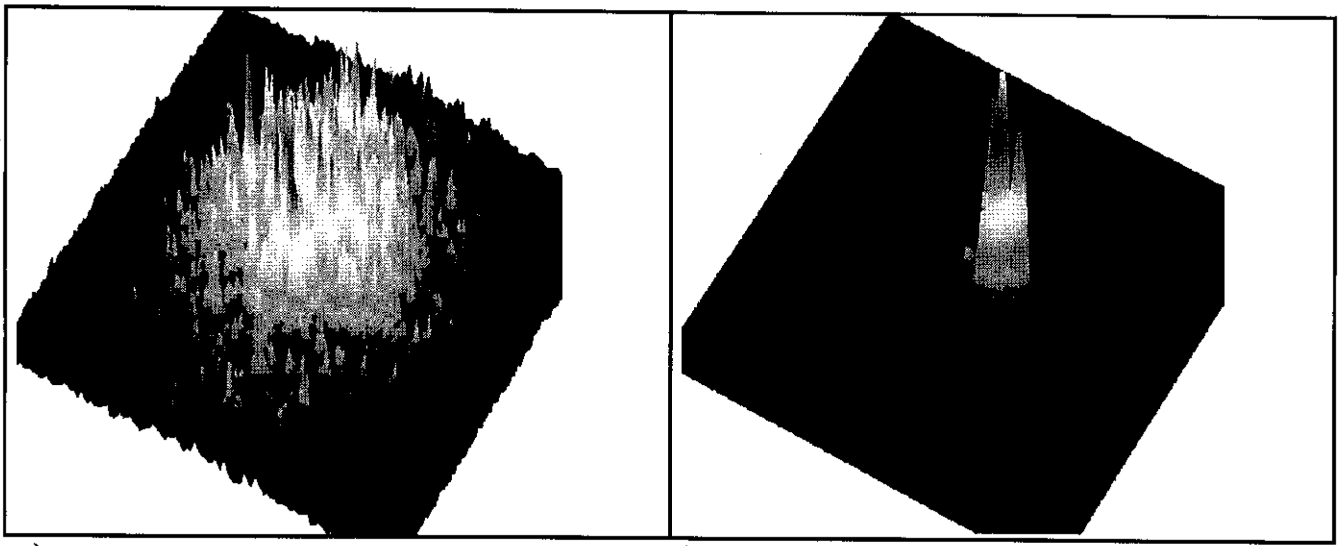
Report: Quasicrystals are highly ordered materials which lack translational invariance. Phason are defects specific to quasicrystals structure, which can lead to Bragg peak broadening (linear phason strain distribution) or diffuse scattering (long wave length phason fluctuations). Both effects have been previoulsy observed by incoherent scattering[1-3-4] on single grain of AlPdMn icosahedral phase.

The aim of this experiment was to study these defects by coherent X-ray diffraction.

A coherent beam of high intensity (10^9 photons/s) was obtained, using a focusing optic and a 10μ diameter pinhole, placed 10cm before the sample. A direct illuminated camera was placed 190cm away from the sample. From small angle scattering we estimated a 50% degree of coherence of the beam, and a stability of few hours.

The Broadened Bragg peaks, have a clear speckle pattern, in place of the smooth Bragg spot image. This is interpreted as the effect of the coherent scattering on a domain structure[2], a result which raises a new point of view on quasicrystals structure. The observation of several Bragg peak shapes confirms the results previously obtained[1], moreover, this broadening is almost isotropic. Annealing the sample at 750°C, improves the sample quality, as shown in fig. 1b). Hower a small phason strain strain is still present after annealing.



a) b)

Figure 1) The 16/16 2-fold axis Bragg reflection, was recorded in two different samples: a) as grown sample b) annealed during 3 days.at 750°C.

We show in the figure 2), that setting the CCD camera in the diffuse scattering of a strong Bragg reflection, during 45 minutes, a speckle pattern sows up (fig. 2a), with a dynamics much bigger than the standard error of count (fig. 2b). Since this diffuse scattering corresponds to phason fluctuations, which aret a diffusive process, we should observe a time evolution of the corresponding speckle pattern, at high temperature (above 500°C).

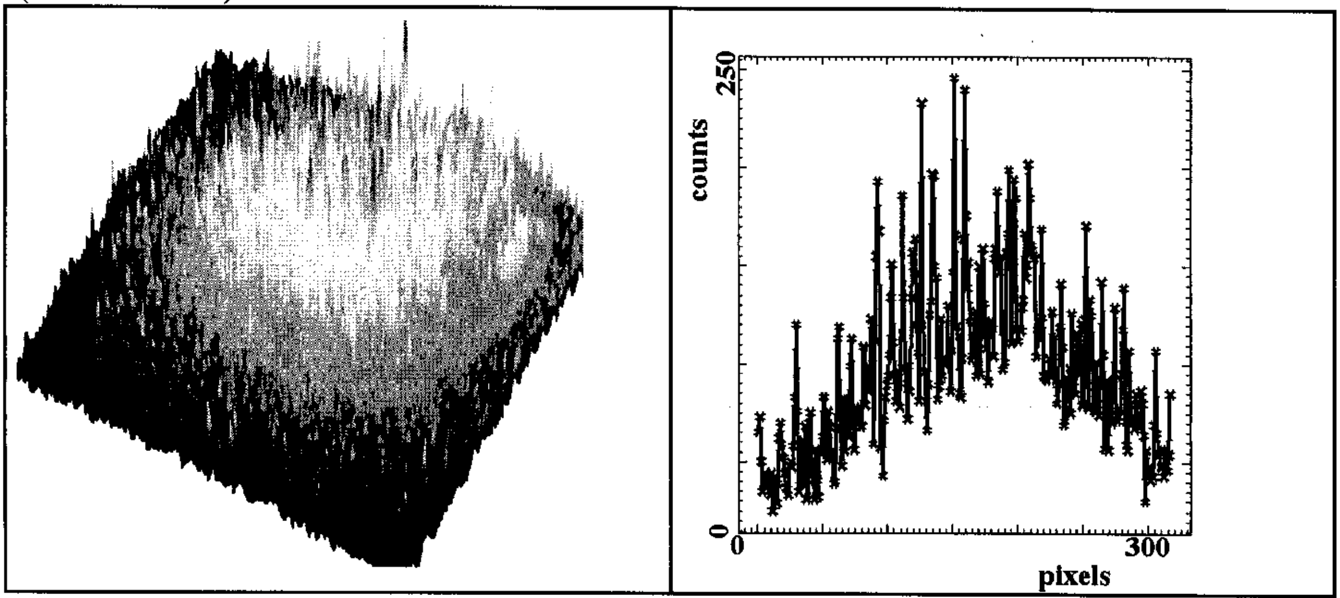


Figure 2a) CCD image of the speckle pattern in the diffuse scattering

Figure 2b) line cut through the CCD image

References:

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