ESRF	**Experiment title:** Identification of the Phonon and Phason Components of Defects in Quasicrystals	**Experiment number:** HS246
Beamline: BL16/ID19	**Date of experiment:** from: 1l/2/97 to: 17/2/97 and from: 28/3/97 to:30/3/97	**Date of report:** 20/08/97
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Report:

The allocated beam time was used to study the defects in real icosahedral quasicrystals (QCs) for the identification of the strain field of the Loop Shaped Defects (LSDs) we observed previously by conventional and Synchrohon White Beam X-Ray Topography (at LURE) both in AlCuFe and AlPdMn grains [1].

We never observed such LSDs at a lower size scale by examining the same type of grains by transmission electron microscopy (TEM), but only dislocation segments [2]. As far as it has been proposed, theoretically, that the strain field around QC defects can be considered as the sum of two components: the phonon strain and the phason strain fields, we have tried to check the extent of these two components around the LSDs, by taking advantage of the ESRF monochromatic beam. It was, in fact, expected that the opportunity offered by the ESRF source to image defects with an improved spatial resolution (because of the small source size and angular divergence) and nearer the core of the defect ("weak beam technique" which allows imaging at the tails of the Rocking Curves (RC)) could be very useful to establish a possible link with the TEM observations [2]. We also used the high coherence properties of the ESRF beams by recording absorption and phase sensitive radiographs of the QC grains. This study was performed in combination with X-ray diffraction topography and a summary of the main results is presented in the *ESRF Highlights 1997.* An example of this type of study is presented in fig. 2 where LSDs are visible together with other defects, holes and precipitates, normally not visible on topographic experiments on QCs.

Accordingly, we investigated AlPdMn grains grown by the Czochralski technique at the LTPCM in Grenoble, by recording X-ray topographs along the RC. Such a recording was performed, using different diffraction vectors g, both in as-grown grains, and in grains having undergone further annealings. The **Full Width at** Half Maximum (FWHM) of the RC we recorded from 3 different as grown grains was of about 1’ of arc, over several mm2, which is comparable to that of the best metallic crystals. We noticed only a slight increase as a function of the annealing time (up to about 1’30” after the 4x24 h annealing at 750°C).

Owing to the smallness of the LSDs after growth and to their entangled configuration, soon after annealing, it has been impossible to follow individually some of them in various topographs recorded using different g and, thereby, to give more precision on their Burgers vectors than in our previous paper [I]. The imaging along the RC, extended far from the diffraction peak, indicates that the LSDs have a non trivial geometry whose complexity increases with the annealing time at 750°C together with their size and density. The LSD networks evolved progressively upon annealing, displaying necklace figures (fig. 1) as we previously reported [l] and having highly misoriented regions which diffract up to about 6’ of arc from the diffraction peak (as recorded for a grain annealed 4x24 h at 750°C. It has been noticed that some of this LSD distorted regions are like points after growth and become elongated during annealings (like streaks), while others are more spread.

Nevertheless further investigations are needed to get the desired information on the strain field around these LSDs (extent and location of the phason and phonon components). From the exposed results emerges the need to repeat the imaging of the LSDs selecting the $\tau^{(n)}$ g reflections, τ being the golden mean $(1+\sqrt{5})/2$ and n an integer number. This type of study will give a bigger strain sensitivity that, toghether with the stereopairs g (-g) analysis, could allow to separate lattice variations from lattice inclination as a possible contribution to the strain field of the LSDs.

REFERENCES

[l] Gastaldi .J, Reinier E., Jourdan C., Grange G., Quivy A. and Boudard M., Phil Mag. Lett. 72 (1995) 311.

[2] E. Reinier,J. Gastaldi, L. Mancini, J. Hartwig, J. Baruchel and N. Baluc, Proceedings of ICQ6, Tokyo (Japan), 26-30 Mai 1997 (in press).

Fig. 1

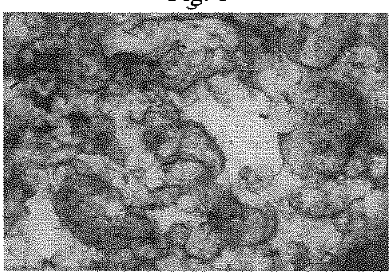
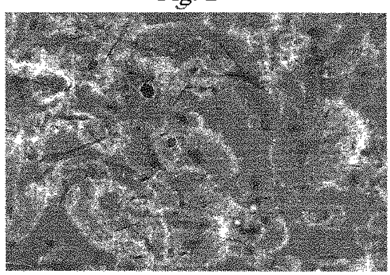


Fig. 2



200 µm

Fig. 1: Loop entanglement appearing as a necklace figure in an AlPdMn grain annealed 4 x 24 hours at 750°C. Image at the top of the rocking curve.

Fig.2: Phase radiograph of the loop entanglement of fig.1. Holes, precipitates and LSDs are visible in the same image

$g = \tau^3(0/\text{-}2\ 0/0\ 0/0)$