



Experiment title:
Irreversible precipitate coarsening of $Al_{0.91}Li_{0.09}$ and speckle fluctuations.

Experiment number:
HS-484

Beamline: ID10A
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Report:

After quench from the high temperature disordered state at room temperature, the single crystal of $AlLi$ was "in situ" aged. at $220C$. The X-ray beam was coherent, and the time evolution of the speckle structure was observed with a "Direct Illumination" CCD detector. The overall degree of coherence of the experimental setup was $\beta \simeq 0.25$.

Typical (incoherent) results The observed scattering in this system is isotropic, if the speckle structure is suitably averaged, as observed in classical (incoherent) Small Angles X-ray Scattering (SAXS).

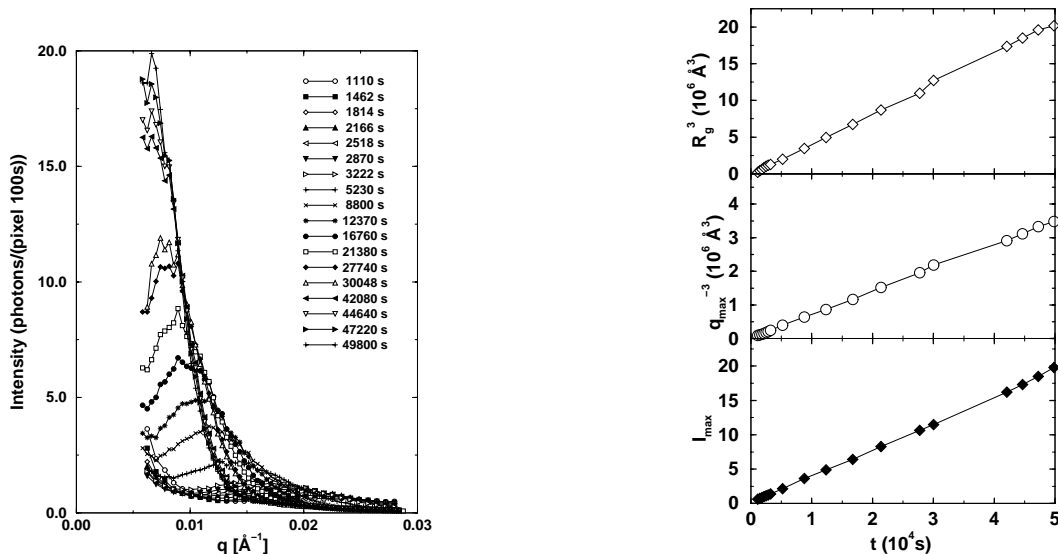


Figure 1: time evolution of the cylindrically averaged intensity observed and of various estimates of the average radius

The system studied clearly shows a $t^{1/3}$ increase of the average radius R of the spherical precipitates.

Coherent scattering During the irreversible evolution of the sample, the speckle structure has been followed. A normalization of the scattering by the averaged intensity of Fig. 1 was carried out, and a normalized scattering was obtained.

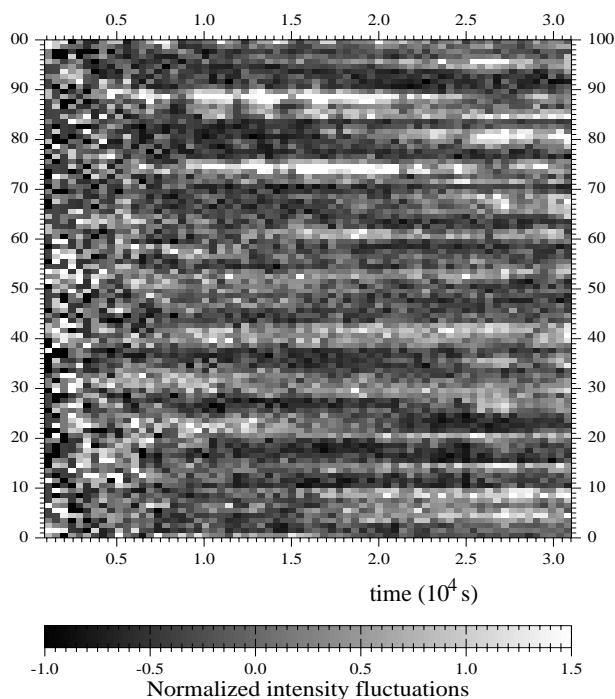


Figure 2 Time evolution of the speckles during the quench process after normalization by average intensity

In Figure 2 are shown the time evolution of this normalized intensity for a set of pixels corresponding to the same $|q|$ value ($q = 0.0117\text{\AA}^{-1}$). Main feature observed is the large persistence of this speckle structure, irrespective to the large evolution of the alloy. The time evolution is longer and longer, and increases roughly like the duration of the unmixing process. Notice that such results correspond to a $\simeq 10$ hours of stability of the experiment for the measurement of the speckle pattern.

Discussion Main explanation for this persistence is in the coarsening process itself: precipitates increase size by redissolution of the smallest, but their relative position, which induce speckle interferences, do not change. Only for long time some contribution of surface fluctuations can be observed. All these results are discussed in details in Ref. 1.

We have to mention the high stability of the setup

References

F. Livet, F. Bley, R. Caudron, E. Geissler, D. Abernathy, C. Detlefs, G. Grübel and M. Sutton, Phys. Rev. E, **63**, p. 036108