X-ray projection microscopy to investigate liquid Ga penetration in Al bicrystals

E. Pereiro-López[1], W. Ludwig[1,2], D. Bellet[3], P. Cloetens[1], C. Lemaignan[3,4]

[1]ESRF, BP 220, 38043 Grenoble, France
[2]GEMPPM, INSA de Lyon, 69621 Villeurbanne Cedex, France
[3]GPM2, ENSPG, INPG, BP 46, 38402 Saint Martin d'Hères Cedex, France
[4]CEA DECDir. , CEA Grenoble, 38041 Grenoble, France

The penetration of liquid Ga along the grain boundaries of Al bicrystals is analysed by synchrotron X-ray projection microscopy. Using Kirkpatrick-Baez focussing optics, a state of the art secondary X-ray source size of 90×90 nm^2 is produced with typical divergences of a few milli-radians [1]. The present investigation deals with one of the very first applications of such a microscope, currently under commissioning at the ID19 beamline of the European Synchrotron Radiation Facility (ESRF, Grenoble, France).

In situ observations of the Ga penetration process reveal linear propagation of the penetration front accompanied by a continuous thickening of the intergranular Ga wetting layer [2,3]. By combining absorption measurements and image correlation techniques it has been possible to characterize simultaneously the presence of nanometric penetration layers and, for the first time, associated continuous relative movement of the Al bicrystal grains of same amplitude [4]. The measured deformation of the bicrystal is compared to the predictions of elasto-plastic crack propagation under mode I loading conditions.

[1] O. Hignette, P. Cloetens, G. Rostaing, P. Bernard, and C. Morawe, Review of Scientific Instruments, to be published (2005).
[2] E. Pereiro-López, W. Ludwig, and D. Bellet, Acta Materialia 52, no.2, 321 (2004).
[3] W. Ludwig, E. Pereiro-López, and D. Bellet, Acta Materialia 53, no.1, 151 (2005).
[4] E. Pereiro-López, Grain Boundary Penetration in the Al/Ga System: a Synchrotron Radiation X-ray Imaging Investigation, PhD thesis from Institut National Polytechnique de Grenoble, France (2004).