doi:10.1017/S1431927611007975
Microsc. Microanal. 17 (Suppl 2), 2011

Detection of a Structural Unit in a [001]45º Tilt Quasi-Periodic Grain Boundary of Al by Doubly Diffracted Electron Diffraction Pattern

M. Shamsuzzoha

School of Mines and Energy Development, University of Alabama, Tuscaloosa, AL

Periodic units of doubly diffracted beams found in the diffraction pattern from a periodic crystal yields a super cell of coincidence lattices of boundary [1]. The super cell is found to accommodate the coincident site lattice (CSL) of the periodic boundary as its basic unit [2]. These studies reveal that non-periodic boundary containing some structural units may yield doubly-diffracted units within the composite diffraction pattern of the boundary. This paper yields periodic units of double diffraction and consequent structural unit found in a [001]45º twist quasi-periodic grain boundary. The boundary was found in a sample of Al prepared by cross rolling and annealing.

Figure 1a and 1b show a nano-probe microdiffraction diffraction pattern taken with electron beam normal to $(001)_1$ and $(011)_2$ of grains of the experimental boundary and corresponding HREM of the boundary respectively. The key to the diffraction pattern of Figure 1b is shown in Figure 1c. The key exhibits individual network of indexed diffraction spots due to each crystal of the boundary. Other spots in the pattern are due to double diffraction. These spots are distributed in terms of two mutually perpendicular sets of layer lines. One set is parallel to the boundary plane and the other set is perpendicular to the boundary plane. The layer lines parallel to boundary plane are uniformly spaced by an amount equaling that of the reciprocal of (100) inter-planar spacing of Al. The layer lines of the perpendicular set do not show any evidence of periodicity amongst them. However, analysis of the later set of layer lines for comparison with the diffraction pattern formed only by the matrix crystals reveals one interesting feature. The feature notes that the width of the first few layer lines as measured from the boundary plane normal is intimately related to the similarly measured width of a parallel line that passes through the 022 diffraction spot of crystal 1 or the 020 diffraction spot of crystal 2. Accordingly, the width of the first layer line is close to $1/7^{th}$ and $1/10^{th}$ of the width of the parallel line that passes through the 020 diffraction of crystal 1 and the 022 diffraction spot of crystal 2, respectively. The relationship of two mutually perpendicular layer lines of double diffraction spots, when transferred in accordance with the reported method [1] to real space yields a two dimensional rectangular unit. The unit thus resulted from the first layer line that is normal to the boundary plane is shown in Figure 2. The unit has the (100) inter-planar spacing of Al as one of its cell edges. The spacing of other cell edges is either close to planar spacing of 10 $(022)_1$ or to 7 $(020)_2$ inter-planar spacing of Al. The stacking ratio of these planes of opposing crystals existing normal to boundary plane assumes a value that is close to $\sqrt{2}$. The HREM image of Figure 1a reveals this unit as the distance between two adjacent steps (indicated by arrows) along the length of the boundary.

References

[1] M. Shamsuzzoha, and R. Rahman, Microscopy and Microanalysis, **14**,598 (2008).
[2] M. Shamsuzzoha, to be submitted too Microscopy and Microanalysis,(2011).

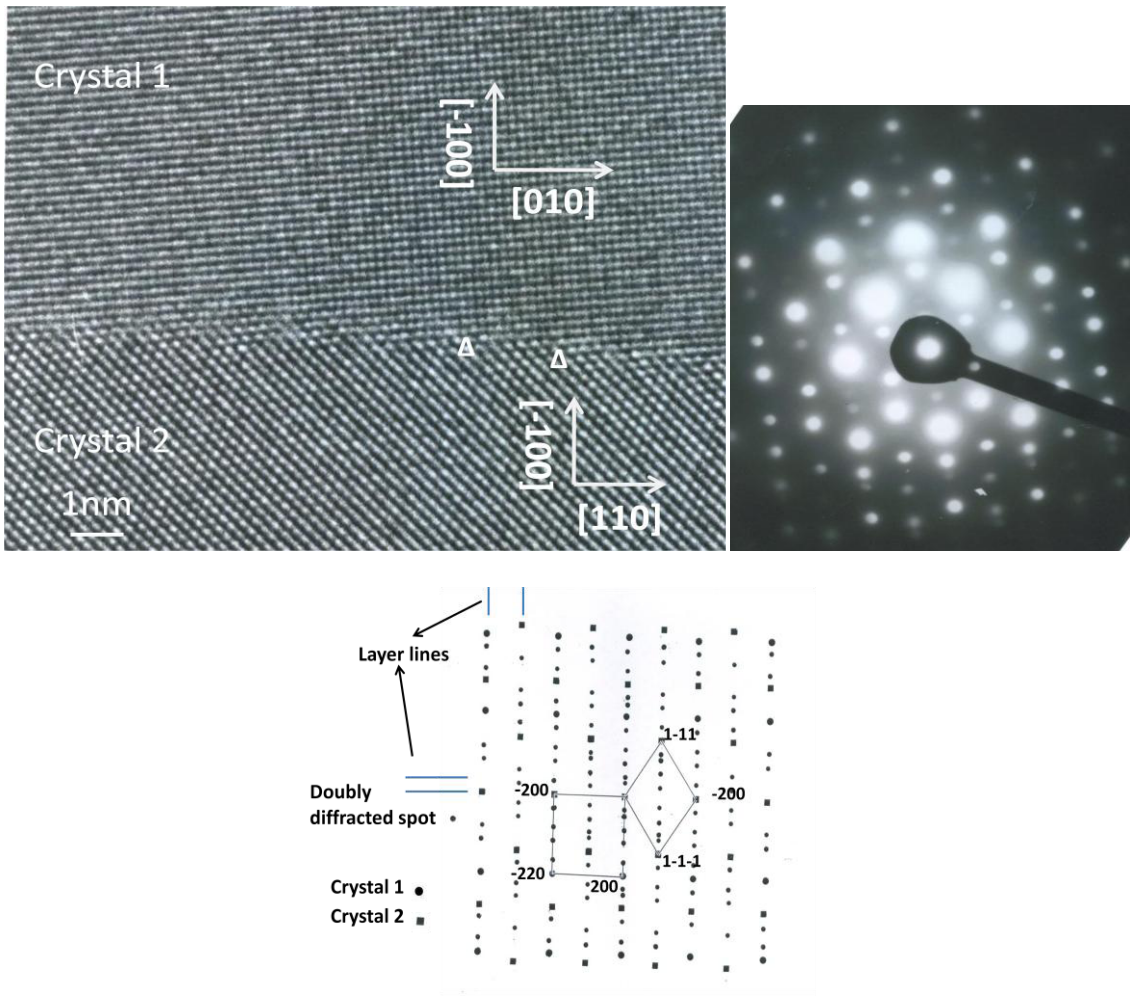

Figure 1 (a) HREM image of [001]45º tilt quasi-periodic grain boundary in Al. (b) Corresponding selected area composite diffraction pattern. (c) Indexing for bi-crystal diffraction pattern.

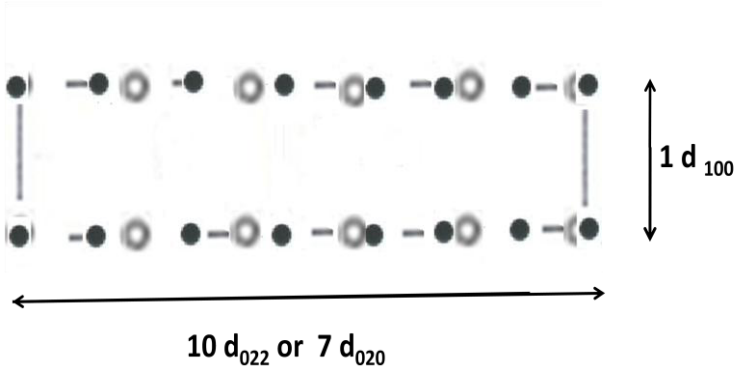

Figure 2 The geometry of the rectangular grain boundary unit, X along $[001]_2$ or $[011]_1$ of the interface of 2(a).

https://doi.org/10.1017/S1431927611007975 Published online by Cambridge University Press