Poster Presentation

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Refinement in 3D Reciprocal Space of ω Forming β Alloy

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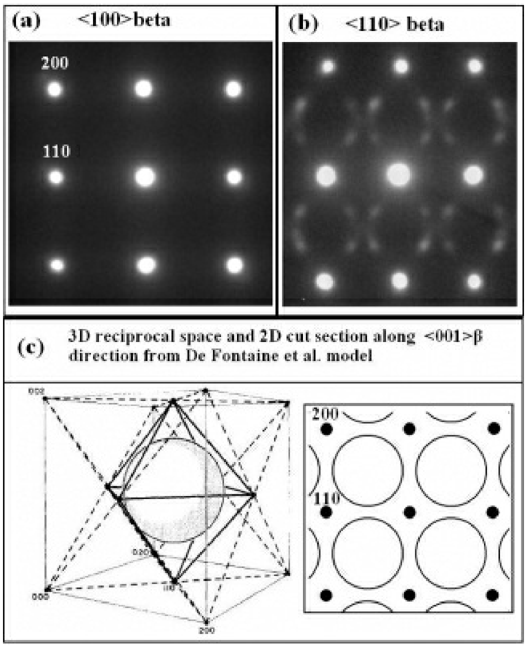
Diffuse arcs have been reported for long in electron diffraction patterns recorded in some bcc transition metal alloys. They have been attracting considerable research interest due to the complexities of arriving at a structural explanation. The diffuse arcs have been correlated with initial stages of ω phase formation from the metastable β phase. Based on the observations on diffuse arcs in <110>, <102> and <113> directions in β phase diffraction patterns, de Fontaine et al. proposed a 3D model of reciprocal space of an ω forming bcc alloy and concluded that the diffuse streak arcs result from short range correlations in the system [1]. According to their model, diffuse arcs are Ewald's sphere intersections in reciprocal space with spherical shells of intensity located at octahedral sites of fcc reciprocal lattice of bcc unit cell. Further investigation in electron diffraction patterns and power spectra from various zone axes reveals that, even though above model is accurate for the zone axes considered by de Fontaine et al., it does not explain diffuse streaks observed along all crystallographic orientations. In this paper, we report on electron diffraction studies on a quenched Ti-15wt%Mo alloy, where we have carried out detailed investigation of diffuse arcs in diffraction patterns from an extended set of zone axes. Some of noted fine features on diffuse arcs that are not explained by the model of de Fontaine et al. are: (a) complete absence of diffuse arcs in <100> (Figure 1a) and <111> diffraction patterns; (b) variation in intensity is observed along diffuse arcs, e.g., circular arcs have zero intensity (Figure 1b) at locations on the diffuse arcs that are on <200> directions; (c) distinct spots are evident on diffuse arcs other than ω reflections which are located near ω reflection positions. Further, de Fontaine's 3D model of the reciprocal space viewed along <100> β direction is as shown in Figure 1c. According to this, diffuse arcs should be observed in <100> β diffraction pattern which is contradicts experimental diffraction pattern where no such diffuse arcs are present (Figure 1a). By considering these facts the existing model of 3D reciprocal space of an ω forming β alloy of quenched stage is refined. In our proposed model, the spherical shell at octahedral sites of the fcc reciprocal lattice that was considered to be of uniform intensity by de Fontaine et al. is replaced with a spherical shell of patterned intensity distribution. High and low intensity regions on the periphery of hollow sphere are identified using different experimental diffraction patterns. 2D planes sectioned from 3D model which are the intersections with the Ewald's sphere have compared with experimental diffraction patterns in various zone axes. The new model of reciprocal space results in a better match since the planar sections replicate experimental selected area diffraction patterns along all the experimentally observed crystallographic directions. The similarities of proposed model with experimental SADP demonstrate, how typical arrangement of spots in 3D can reflect as streaks in 2D.

[1] De Fontaine D. et al. (1971) Acta Metallurgica 19(11) 1153-1162.



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