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Study of double-ended dislocation pile-ups in heterogeneous anisotropic elasticity

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Recently, the analysis by AFM of the slip step height profile in an α-Brass bi-crystalline micropillar indicated the presence of a double-ended dislocation pile-up, i.e. dislocations had piled-up both at the grain boundary and at the external surface [1]. At a free surface, dislocations cannot pile-up as they will escape the material due to attractive image forces. Thus, a rigid surface or more realistically, a stiff layer adjacent to the surface (e.g. due to FIB machining) should be considered in order to provide a stabilizing repulsive stress. Such a configuration may have complex effects since dislocations interact with more than one surface/interface. Therefore, a numerical study of a double-ended dislocation pile-up model is proposed. It is based on the image decomposition method [2] and the Leknitskii-Eshelby-Stroh (LES) formalism to compute dislocation stress fields in anisotropic multilayers. The effects of surface conditions, grain boundary and critical stress on discrete dislocation positions in the double pile-up are analyzed both at loading and unloading [3].

Keywords: Dislocation pile-up; Grain boundary; Anisotropic elasticity; Image stress

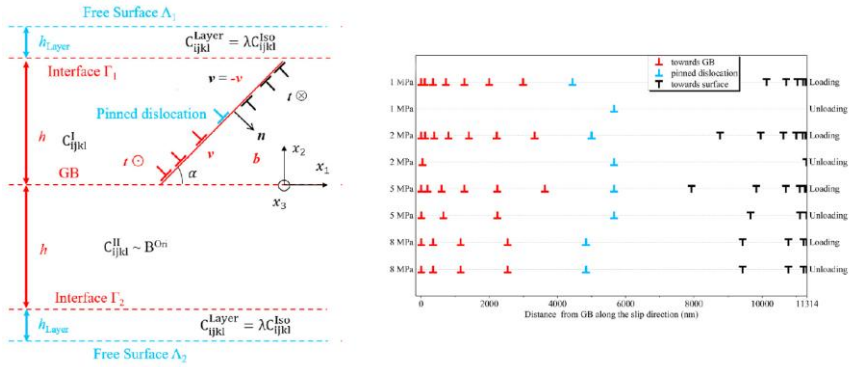

Fig.1: Left: Double-ended pile-up with stiff layers adjacent to free surfaces. Right: Corresponding dislocation equilibrium positions for different critical stresses.

References:

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