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Theory of twin strengthening in fcc high entropy alloys

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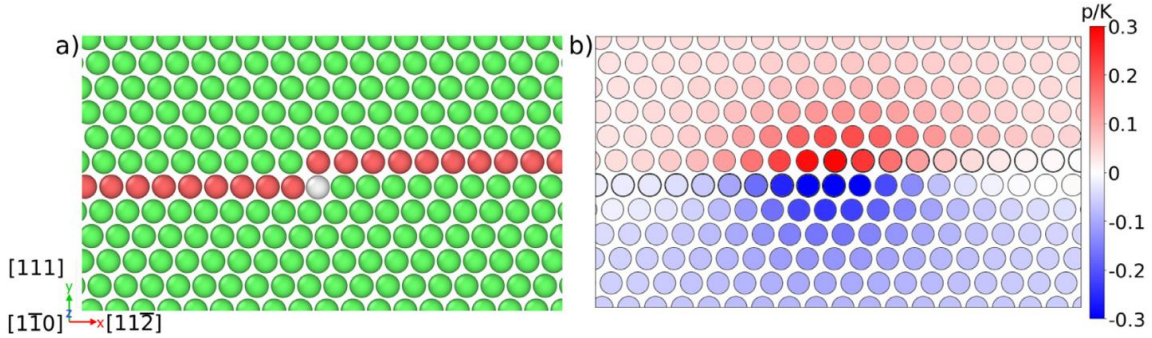
Twinning in fcc High Entropy Alloys (HEAs) has been implicated as a possible mechanism for hardening that enables enhanced ductility[1]. A theory for the twinning stress is developed analogous to recent theories for yield stress[2]. Specifically, the stress to move a twin dislocation, i.e an fcc partial dislocation moving along a pre-existing twin boundary, through a random alloy is determined. A reduced elasticity theory is then introduced in which atoms interact with the twin dislocation pressure field and the twin boundary. The theory is applied to NiCoCr using results from both interatomic potentials and elasticity theory. Results are also used to predict the increased stress for the motion of (i) a single partial dislocation leaving a trailing stacking fault and (ii) adjacent partial dislocations involved in twin nucleation. Increased strength is predicted for all processes involved in the nucleation and growth of fcc twins. Comparison to single-crystal experiments at room temperature then suggests that twinning is controlled by twin nucleation. When solute/fault interactions are neglected, the theory shows that twinning and lattice flow stresses are related [3].



Keywords: Twinning, Solute strengthening, Random alloys

Fig.1 Atomic configuration of a pure edge twin dislocation lying on the twin boundary and the normalized pressure field along the boundary in a model NiCoCr alloy.

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