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A Portevin–Le Chatelier Effect expected from Solute Atmosphere Dragging*

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Abstract

A solute atmosphere, will be formed around a moving dislocation in a solid solution, when the dislocation velocity is smaller than the critical value

\[ v_{CL} = AD/kTb^{2} \]

for the case of solute atoms interacting hydrostatically with an edge dislocation, where \( A \) is a parameter indicating the strength of the interaction, \( b' \) is a distance of the order of the interatomic one, and the other parameters have their usual meanings. There may exist another critical velocity (Cottrell 1953a), \( v_{CH} \), which corresponds to the maximum drag stress due to the solute atmosphere.

In the range of \( v_{CH} < v < v_{CL} \), a moving dislocation will be subjected to a lower dragging stress with higher velocity. A kind of Portevin-Le Chatelier effect is expected from this dynamical instability of plasticity.