ME530

HW4

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Discuss the application of compatibility to fatigue.

In a polycrystalline material, standard schmid factors are not enough to predict the activation of slip. With the presence of grain boundaries, the interface between grains, each grains is interact with neighboring grains of different orientations. As we learned in the class, dislocation motions can be categorized into three cases: Transmission, block and partial transmission. As a result of dislocation motions, strain incompatibility between grains builds up in the process and compatible stress is introduced to satisfy the displacement (strain) continuity condition. Thus, being able to account for the compatibility stresses is significant as standard schmid factors cannot make accurate predictions on the activation of slip systems.

As shown in the figures of Peralta's paper, compatibility stresses and principal stresses change as a function of angles (either loading direction or grain orientations) and the stress concentration is maximum at <111> direction. This indicates there is a correlation between texture and twin boundaries. Based on this, we can predict that crack starts to form at twin grain boundaries oriented at <111>. However, there are other factors involved in strain localization and crack nucleation under fatigue and for this reason, it is worthwhile to study and understand topics such as singularity at grain boundary, role of precipitates, and dislocation channeling.