Crystallographic principles of plastic deformation in polycrystalline metals

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Abstract

As is well known, external stress causes plastic deformation of polycrystalline metals, during which the grains are always bearing overlapping stresses from external and intergranular interactions. In comparison with the observations of real deformation, the crystallographic process for achieving this plastic deformation behavior, namely the activation process of dislocations and mechanical twinning penetrating or non-penetrating grains in different metals, was gradually elucidated. However, predetermined strains rather than actual stresses are taken as initial point in the Taylor principle commonly used in current deformation crystallography to explain the plastic behavior of grains, which has led to some difficulties in the physical background, practice, and theory. It is practically indicated that the combined activations of deformation systems penetrating and non-penetrating grains under the external and intergranular interaction stresses and the corresponding elastic-plastic behavior of grains are more simple, natural, reasonable in theory, which could be used well to trace orientation evolution and texture formation of fcc as well as bcc and hcp metals during deformation, while the Taylor principle is no more necessary.

Keywords: Deformation crystallography, rolling texture, polycrystalline metals, Taylor principle

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