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Recent studies / concepts in the crystal plasticity-Copper (Cu)- modelling, attempting to account for the discrete nature of dislocation glide (non-local theory)

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Abstract / Introduction

As the material is subjected to loading, the applied stress resolved along the slip direction on the slip plane initiates and controls the extent of dislocation glide. This latter has the effect of shearing the material, while the volume remains constant and the crystal lattice remains unchanged. Moreover, the crystal lattice can deform elastically, but elastic strains are small compared to plastic strains and are sometimes neglected in crystal plasticity models. Finally, the crystal lattice can also rotate to accommodate the applied loading. In crystal plasticity theory, plastic deformation is modelled using the slip system activity concept. Dislocations are assumed to move across the crystal lattice along specific crystallographic planes and directions. This lattice rotation (or spin), is responsible for texture development. The concept of lattice rotation in crystal plasticity is not, at first hand, easy to grasp, especially compared to material rotation (or rigid body rotation).

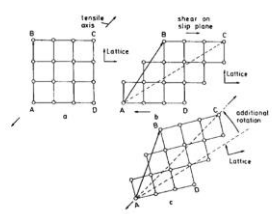

Figure1. Poz. (a) and (b) A shear **γ** on a slip plane does not cause the lattice to rotate,

These considerations form the basics of classical crystal plasticity theory. Other models of deformation in polycrystals like ***twinning or grain boundary sliding are not tackled in this work.*** Also, more recent concepts in crystal plasticity modelling, attempting to account for the discrete nature of dislocation glide (non-local theory) are briefly highlighted**.** The main objective of this study is to deepen the understanding of strengthening mechanisms in the Cu alloy using *in situ* TEM mechanical testing. The local composition and microstructure characterized by (S)TEM and atom probe tomography (APT) are correlated with the stress–strain curves and dislocation motion measured by *in situ* TEM deformation tests. We examine the threshold stress for dislocation glide and relate the observations to strengthening mechanisms. Several researches / industrial studied / discussed to show and handle some challenges for the advanced optimization of the process through AI simulation. Use / dedicated to AI-sensors, aircraft memory, new semiconductors, nanoelectronics