A 3-dimensional perspective on twin growth and transmission in HCP metals

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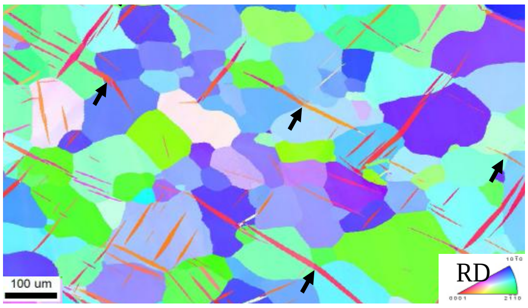
Twinning is a crystallographic reorientation mechanism induced by applied stress which accommodates plastic shear in an amount proportional to the volume of the reoriented domain. Traditionally, twin studies have focused on a 2D characterization of twin propagation and its transmission across grain boundaries. Twin propagation, however, is a 3D process that takes place via growth of the twinned domain, a highly anisotropic process involving the migration of the crystallographic facets that bound the domain [1]. In addition, twin transmission across grain boundaries also takes place in all directions, and depends on atomic reactions at the GB and on the orientation of the neighbor. In the last few years our group has focused on characterizing such 3D processes experimentally (using EBSD and HR-TEM combined with multiple sectioning) and theoretically (using Molecular Dynamics, Phase Field, and Crystal Plasticity) [2]. In this presentation we show that these studies, combined with statistical analysis, provide a completely new insight on twin growth and twin transmission in Mg and Ti, improve our understanding of twinning, and help in developing criteria for modeling twinning in crystal plasticity simulations.



EBSD evidence of {1012} twin transmission in Mg

Keywords: EBSD, TEM, 3D, twin growth, twin transmission

References

[1] S. Wang et al., “Three dimensional facets in {11-22} compressive twin boundaries in Ti”, Acta Materialia 208 (2021) 116707.

[2] K. Dang et al. “Atomistic and phase field simulations of three dimensional interaction of {10-12} twins with grain boundaries in Mg: twin transmission and dislocation emission”, Materialia 20 (2021) 101247.