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A Correlation Between Grain Boundary Character and Deformation Twin Nucleation Mechanism in Coarse-grained High-Mn Austenitic Steel: In-situ deformation TEM

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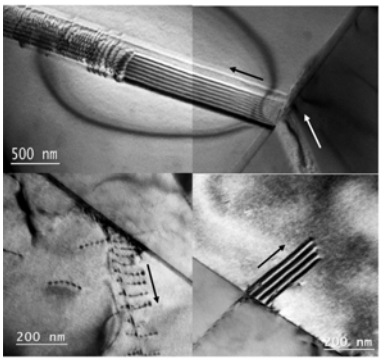
Abstract



In polycrystalline materials, grain boundary is known to be a critical microstructural component controlling material properties, and its character such as misorientation would influence the dislocation dynamics. Nevertheless, many of generally accepted mechanistic models for deformation twin formation such as cross-slip and three-layer twinning mechanisms do not take the role of grain boundary on deformation twinning nucleation into account. In this presentation, we experimentally reveal that a deformation twin nucleation occurs at an annealing twin (S3) boundary when dislocations pile-up at the S3 boundary and produce a local stress that exceeds the twining stress, while that occurs without requiring an obvious local stress concentration at relatively high-energy grain boundaries such as S21 or S31. A periodic/sequential contrast reversal in stacking faults emitted from the S3 boundary was observed by our in-situ transmission electron microscopy (TEM) deformation experiments. The contrast turning around demonstrates that a successive layer-by-layer stacking fault emission is the deformation twin nucleation mechanism at both low and high S-value boundaries in this study, different from the conventional three-layer deformation twinning mechanism. These results experimentally confirmed that the deformation twin nucleation occurs at grain boundaries by a layer-by-layer stacking fault emission mechanism in addition to the grain interior by conventional deformation twinning mechanisms, and the grain boundary character and local stress play a significant role on the deformation twin nucleation.

Biography Chang-Yu Hung is a Ph.D. candidate advised by Dr. Murayama in the MSE department. He received his bachelor and master's degree in Materials Science & Engineering from National Chung Hsing University, Taiwan, in 2011 and 2015. Before starting his Ph.D. in VT, he was a research associate for the studies on dye-sensitized solar cell in National Taiwan University. In summer 2020, He did an internship at Idaho national lab for the characterization on irrdiated urinium oxide fuel using TEM. His Ph.D dissertation now focuses on the deformation behavior of TWIP steel using postmodern TEM and in-situ deformation TEM technique.