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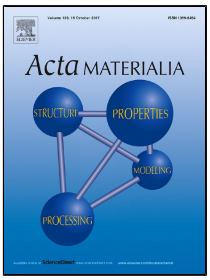

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Unraveling the Origin of Twin Related Domains and Grain Boundary Evolution During Grain Boundary Engineering

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Abstract: Grain boundary engineering of Fe-based austenitic stainless steels and other materials has been successful in producing a large increase in twin and twin related grain boundaries from a wide range of thermomechanical treatments. However, the exact mechanisms and effective grain boundary network descriptors to create the heavily twinned microstructures are yet to be fully understood. In this study, we provide insight into the grain boundary engineering process by examining sequential progression of the same spatial location of a twin related microstructure through thermomechanical processing. The results show that clusters of twin related grain boundaries called twin related domains form during primary recrystallization. The size of the twin related domains increases as the level of strain falls toward the critical strain for recrystallization. Growth of twin related domains during recrystallization results in the formation of twin boundaries behind the migrating grain boundary front. Formation of higher order twin boundaries occurs when two separate grain boundary fronts of the same twin related domain impinge upon each other. We also present relevant microstructural descriptors with emphasis on twin related domain statistics to recrystallization phenomena in grain boundary engineering materials.

Keywords: Recrystallization; Twin boundary; Grain boundaries; EBSD; Grain growth