The formation mechanisms and interface character distributions of Widmanstatten austenite in a duplex stainless steel

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A detailed study was conducted on the BCC to FCC phase transformation occurring during air-cooling of a delta-ferritic microstructure in a 23Cr-6Ni-3Mo duplex stainless steel. Such a cooling rate resulted in a Widmanstätten morphology of austenite, presumably formed through a semi-shear transformation, co-existing with coarse-grained delta-ferrite. A detailed TEM analysis revealed the co-operation of sympathetic nucleation and the instability mechanisms during the formation of Widmanstätten austenite plates. A five-parameter analysis of the interfaces showed that about 40% of the austenite-ferrite interfaces were of rational orientation relationships (ORs), i.e., Kurdjumov-Sachs (KS) and Nishiyama-Wassermann (NW), and for these interfaces ferrite and austenite terminated on (110) and (111) planes, respectively. Within this microstructure, the allotriomorphic austenite had a relatively lower fraction of KS/NW ORs (i.e., 23%) compared with the intragranular elongated austenite (i.e., 42%). The non-KS/NW ORs mostly corresponded to (111) interphase planes for both austenite and ferrite. Most of the austenite-austenite boundaries were of Σ3 and Σ9 configurations, showing pure twist and tilt characters, respectively. Furthermore, it was found that the austenite-austenite boundaries formed as a result of the impingement of the K-S and N-W variants display more frequent {111} orientations than other planes.