Commercial titanium alloys undergo a series of thermo mechanical processes and subsequent heat treatments at the high temperature β (BCC) phase and lower temperature α + β (HCP+BCC) phase to achieve desired properties. The microstructure and global texture is heavily influenced by the processing parameters such as temperature, strain and strain rate. The Widmanstätten α (HCP) laths form by slow cooling of β or isothermal aging at α + β phase maintaining a Burgers orientation relationship (BOR) with β phase given by (1-10)β || (0001)α and <111>β || <11-20>α. Upon thermo mechanical processing and subsequent heat treatment, the lath structure transforms to equiaxed, a process known as globularization. The globularization does not lead to a completely random texture and many times, we may retrieve the original α orientation with certain spread even after heavy deformation. In addition, the microtexture associated with globularization is an interplay between the α and β phases and recrystallization in β can happen in combination with α to form special angle, epitaxial grain boundaries in both α and β phases as suggested by some previous studies in this direction [1][2].

In the present work, we incorporate transmission electron microscopy (TEM) based orientation electron microscopy (OIM) assisted by precession electron diffraction (PED) to investigate the triggering points of recrystallization events having special angle boundaries in both α and β phases, at resolutions beyond conventional scanning electron microscopy (SEM) based electron backscattered diffraction (EBSD). A 200 KV FEI T20 S-TWIN microscope coupled with Nanomegas-ASTAR precession and data collection system was used for this study. Events of epitaxial recrystallization of fine α associated with special angle boundaries in β around the alpha was frequently observed. Two interesting examples are shown here. In Figure.1, the recrystallized α maintains a common <10-11> pole with the other α with a special β grain boundary evolving from α / α interface. In Figure.2, a fine β layer is observed around the globularizing α laths maintaining BOR with α and in special angle boundary with parent β grain, suggesting altogether a new mechanism for α globularization. Many more of the above discussed events were observed in our study. The resulting global texture is a sum of these discontinues recrystallization events and the deformation texture associated with parent β and α phase. We have observed consistently that the original BOR is restored by these events.


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Fig. 1: Epitaxial recrystallization in α phase associated with special angle grain boundaries in β and related 10-11 and 110 pole figures with common poles.

Fig. 2: Globularization in α associated with formation of fine β layer, which is in BOR with α and maintains special angle relationship with parent β grains.