New insights into the texture development during processing of dual phase titanium alloys

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Abstract

The macrotexture and microtexture of alpha-beta Ti alloys have strong effects on the cold creep and fatigue life of these materials, especially when the load cycle includes a dwell period. Although the fundamental mechanisms responsible for texture evolution are well-known, it is still not possible to predict with confidence the texture and microtexture variation in a component. This is because the texture development in these materials is a complex problem, involving the co-deformation of two phases, one of which is highly anisotropic, recrystallization and also phase transformation. In order to improve our predictive capability, we need to better understand the relative importance of these different mechanisms. Here, we present the results of a major effort to advance our understanding of the texture development during processing of these important materials. Our results show that, in most cases, the characteristic texture components develop primarily through deformation, and that recrystallization and phase transformation play only a smaller role. We found no evidence of dynamic phase transformation. Crystal plasticity modelling results, using phase material parameters calibrated using in-situ synchrotron data, showed that the local deformation conditions within the material can be very different from those imposed at the macro scale, due to the large contrast in flow stress between the beta and alpha phase. This helps explain the development of strong microtextured regions, even after large deformations, and also why the starting microstructure and texture of the material can affect the final texture so strongly. Recrystallization was found to be most important to the development of texture in the beta phase, especially at high temperatures. Strong beta textures produced in this way can lead to the development of abnormal grain structures during beta annealing. Work is now underway to integrate these findings into a complete model of texture evolution.

Keywords: titanium, microtexture, crystal plasticity, thermomechanical processing

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