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Micromechanical response of commercially pure titanium

Insights from experiments and simulations

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A microstructural patch of polycrystalline commercially pure titanium obtained through Electron Back Scattered Diffraction (EBSD) was used to study the slip activity, heterogeneous stress distribution, and texture evolution during uniaxial tensile deformation through a combination of experiments and crystal plasticity fast Fourier transform (CPFFT) simulations. The differences in the above-mentioned aspects while deformed along the rolling and transverse directions were studied. A higher strain hardening was observed when deformed along the rolling direction when compared to the transverse direction which was attributed to the higher activity of prism slip. While a texture component with RD || <10$\bar{1}$0> was observed when deformed along rolling direction, a component in between <0001> and <10$\bar{1}$0> was observed for transverse direction loading. It was observed that some of the grains developed higher amount of stress post-deformation. These locations are termed as stress hotspots which interestingly was observed to be higher when deformed along rolling direction. These hotspots, irrespective of the loading direction had a similar initial orientation. The presence of large number of grains with this orientation resulted in the higher number of stress hotspots in rolling direction samples.

Keywords: Commercially pure titanium, EBSD, CPFFT, DAMASK, Stress hotspots.

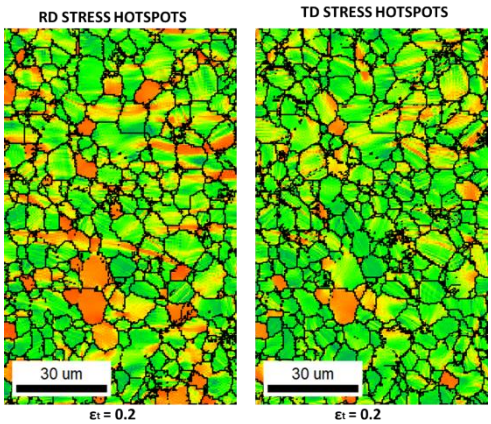

Fig 1. Stress Hotspots in RD and TD at $\varepsilon_t = 0.2$.

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