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Understanding the deformation mechanism of individual phases of a dual-phase beta type titanium alloy using *in situ* diffraction method

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ABSTRACT

An *in situ* tensile X-ray diffraction (XRD) set-up with an area detector was employed to characterize deformation behaviors of individual phases in a commercial dual-phase β -Ti alloy. A developed analytical approach based on the modified Williamson-Hall plot accounting for dislocation evolution was proposed to elucidate the deformation mechanism of each phase from the *in situ* XRD data. A commercial purity titanium (α type, α -Ti) alloy was examined as a comparison to assist identifying the influence of inter-phase interaction on the deformation behavior of the β -Ti alloy. We found that the small amount of the fine lamella shaped hcp (α) precipitates, which is only 5% in volume, has great effects on the deformation mechanism of the bcc (β) matrix in the β -Ti alloy due to the Burger's orientation relationship (BOR) between the two phases. Due to the reason that slip on the coherent plane of $(211)_{\beta}$ of the β phase (*i.e.* $(10\bar{1}0)_{\alpha}$ plane of the α phase) is more predominant than that of $(110)_{\beta}$ plane (*i.e.* $(0002)_{\alpha}$ plane) in a hcp polycrystal, slip on $(211)_{\beta}$ plane is easier than that on $(110)_{\beta}$ plane in the β -Ti alloy (*cf.* $\{110\}\langle 111\rangle$ is the typical slip system in single phase bcc polycrystals). Although slip on $(211)_{\beta}$ plane is the most facile, lattice strain on $(211)_{\beta}$

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