Effect of texture on deformation behaviour of titanium in the presence of hydrogen

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Abstract

The role of initial texture on the mechanical behaviour of hexagonal close pack (HCP) titanium in the presence of interstitial hydrogen was studied. Tensile samples with two distinct orientations-off-basal (BA) having higher twin activity and prismatic-pyramidal (PP) were subjected to electrochemical hydrogen charging. The uniaxial tensile test performed displayed an increased yield strength but decreased ductility in H-charged samples. Fractography analysis revealed distinct dimple sizes and fracture surfaces at high magnification in the H-charged and uncharged samples. A detailed microstructure characterization using electron back-scattered diffraction and synchrotron X-ray diffraction (SXRD) measurements was carried out at three strain levels determined by 2D-digital image correlation (DIC) data to gain insight into the deformation mechanisms involved in the presence of hydrogen. In this work, the correlation between mesoscopic and microscopic deformation characteristics i.e. tensile data, work hardening behaviour, slip and twin activities, slip character, and texture evolution will be elaborated to yield crucial insights into the underlying damage micro-mechanisms influenced by hydrogen presence in titanium.

Keywords: Texture, Hydrogen, Digital image correlation, EBSD, Plastic deformation

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