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Investigation of sub-grain deformation processes of an In718 Alloy from room temperature to high temperature using High-Resolution Digital Image Correlation

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Investigating the localization of the plasticity at the microstructure scale is critical to better relate the mechanical properties of polycrystalline materials to their microstructures. The temperature dependence of the localization of the plasticity is presently investigated during monotonic loading on a polycrystalline In718 Ni-based superalloy. Tensile tests under controlled atmosphere were performed at room temperature, 350°C, and 650°C. While transgranular slip was the primary deformation mechanism observed at room temperature and 350°C, grain boundary sliding was observed to control plastic deformation at 650°C. This intense strain localization in the vicinity of grain boundaries was observed without the assistance of transgranular slip events. High Resolution-Digital Image Correlation (HR-DIC) measurements[1,2] were used to quantitatively and statistically capture the localization of the plasticity as a function of the microstructure and involved deformation mechanisms. Moreover, the grain boundary sliding intensity in the In718 Alloy was found to be sensitive to the applied strain rate and lead to premature intergranular cracking at low strain rate. Scanning electron microscopy and transmission electron microscopy observations were performed to document dislocation structures related to transgranular and intergranular sliding events.

Keywords: Superalloys, slip activity, grain boundary sliding, digital image correlation (DIC)

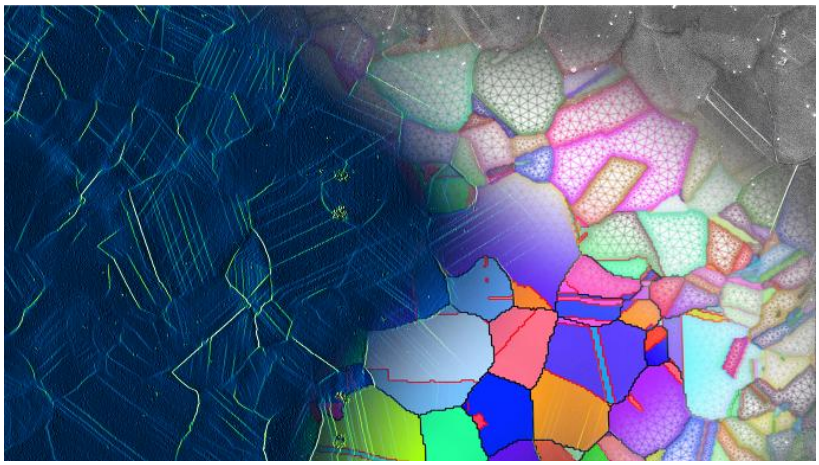

Fig.1: Combination of strain maps (DIC), EBSD maps, finite element mesh and micrographs to document strain distribution in the In718 Alloy at 650°C at the microstructure scale.

[1] J.C. Stinville et al., "Sub-grain scale digital image correlation by electron microscopy for polycrystalline materials during elastic and plastic deformation." *Experimental mechanics,* vol 56(2), 2016, pp. 197-216.

[2] J.C. Stinville et al., "Measurement of strain localization resulting from monotonic and cyclic loading at 650◦ C in nickel base superalloys." *Experimental Mechanics,* vol 57(8), 2017, pp. 1289-1309.