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Evolution of crystallographic orientation during thermomechanical fatigue of heat-resistant stainless steel

Godwin Kwame Ahiale^a, Ji Sung Yoo^b, Sunghak Lee^b, Dong Yong Park^c, Yong-Jun Oh^{a*}

^aDept. of Materials Science and Engineering, Daejeon 34158, Republic of Korea

^bCenter for Advanced Aerospace Materials, Pohang University of Science and Technology, Pohang 37673, Republic of Korea

^cSolar Thermal Convergence Laboratory, Korea Institute of Energy Research, Daejeon 34129, Republic of Korea

Abstract

We present the evolution of crystallographic orientation and microstructure during thermomechanical fatigue (TMF) of heat-resistant cast austenitic stainless steel at peak temperatures reaching 950 °C using the electron backscatter diffraction (EBSD) method. Higher restraints or peak temperatures induced larger crystal misorientation by geometrically necessary dislocations (GNDs), forming dislocation walls or subgrains in the grains. Networked carbide clusters in the microstructure locally amplified the misorientation in the adjacent matrix and initiated fatigue cracks. The mean value of cumulative misorientations over a specific distance in the matrix was linearly proportional to the cyclic plastic strain.

Keywords: Electron backscattering diffraction (EBSD); Austenitic steel; Fatigue; Misorientation; Dislocation structure; Plastic strain

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