IIIa09-006

Microstructural changes in additively manufactured Co-Cr-Mo alloy during cyclic loading

Saraiva, B.R.(1); Novotný, L.(2); De Barros Neto, J.R.(3); Masoumi, M.(4); De Abreu, H.F.G.(1); Béreš, M.(1);
(1) UFC; (2) FUBB; (3) UFPI; (4) UFABC;

Cobalt-Chromium-Molybdenum (CoCrMo) alloys are used in applications that require high strength and wear resistance. Examples in biomedical include artificial hip and knee joint implants subjected to repetitive loads during the service. The cyclic loading implies high fatigue strength as a fundamental mechanical property, besides those already pointed out. In this regard, it is crucial to understand the mechanism associated with the crack propagation under cyclic loading, which is the subject of the present work. Tensile test specimens were fabricated using the laser powder bed fusion (LPBF) additive manufacturing technique and examined in the as-built condition. Then, the samples were subjected to cycling loading with tension load applied above the yield strength and subsequent tension release. Microstructural changes that occurred were followed using the Electron Backscatter Diffraction (EBSD) technique. Hence, it was possible to trace deformation-induced phase transformation from face-centered cubic (FCC) to hexagonal close-packed (HCP) structure. Our investigation revealed that cracks nucleated at grain boundaries. In addition, it was observed that the crack tip was deflected when encountering a grain boundary unfavorably oriented to the crack propagation. Then the crack tip propagated further at the HCP phase. Therefore, FCC to HCP deformation-induced martensitic phase transformation serves as a preferential path to crack propagation when the crack tip encounters a barrier such as a grain boundary.