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Dislocation cell structure induced long range internal stresses and strain hardening modelling of direct metal laser sintered SS316

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Dislocation cell structures as developed in the stage III of strain hardening or under cyclic loading are known to impart intragranular long range internal stresses. Similar dislocation cells have been a debated feature of the additively manufactured microstructures in terms of its origin and strengthening contributions. In this investigation as printed SS316 alloy was given systematic heat treatments to obtain microstructures with and without dislocation cells which were thereafter examined for the presence of long range internal stresses using synchrotron diffraction technique. Realizing the composite type structure of the additively manufactured (AM) microstructures, three internal variable based constitutive model has been developed to capture the strain hardening response and underlying deformation mechanisms. Significant peak asymmetry in the presence of cells suggests the existence of long range internal stresses in the as printed state which is identified to play a crucial role in dictating the strength and strain hardening behavior of AM microstructures.

Keywords: *Additive Manufacturing, dislocation cell structure, strain hardening, constitutive modelling*