DESIGN AND PROPERTIES OF STEELS PRODUCED BY ADDITIVE MANUFACTURING

Massimo Pellizzari

University of Trento, Department of Industrial Engineering, Via Sommarive 9, 38123 Trento, Italy

Email: massimo.pellizzari@unitn.it

Abstract

The popularity of Additive Manufacturing is rapidly growing thanks to the possibility to produce complex three-dimensional parts directly from CAD models. Steel in the as-built condition typically show a finer solidification microstructure respect to the same parts produced by conventional routes. In general, also the properties are very good, provided that the microstructure is properly modified by suitable heat treatment and finishing. The elimination of post-heat treatment still represents a tough challenge for AM, due to the poor homogeneity of the solidification structure and the limited toughness and ductility arising from the possible formation of hard and brittle phases. However, the intrinsic heat treatment taking place during 3D printing is difficult to be controlled, also considering that the parameters are typically optimized to achieve fully dense parts and to maximize productivity. Moreover, a post-heat treatment is necessary to improve the microstructure produced by rapid solidification, optimize the properties, and recover internal stresses.

In this work, the influence of heat treatments on the properties of some tool steels produced by Laser powder bed fusion (LPBF) and Direct Energy Deposition (DED) is considered. Results on DED aimed at repairing of tools and dies will be reported. The microstructure and properties like hardness, hot strength, fracture toughness, and thermal fatigue resistance can be tuned after suitable heat treatment.