Fabrication of 4130 Steel Powder for 3D Printing and Its Simulation Study

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Abstract

AISI 4130 grade is an alloy steel containing chromium and molybdenum as strengthening agents. The steel has a good strength, toughness, fatigue strength, weldability and machinability. These intriguing properties motivated us to make the 4130 powder via milling process and explore the feasibility of 3D printed 4130 parts for industrial applications in future. Studies show that cyclic jet milling making the particle sphere-like shape that enhances the flowability of iron powder to ~ 38 g/sec. Incorporation of chromium, manganese, carbon, silicon, molybdenum, sulfur, phosphorous reduces the flowability of 4130 powder. The EDS shows our home-made 4130 powder has good uniformity and the chemical composition well agrees with conventional 4130 powder.

Selective Laser Melting (SLM) is the commonly used technique to produce 3D printed metal parts for various applications. However, the optimum process parameter like scanning speed, laser power, hatch distance change from powder to powder. In this work we present detailed characteristics of our 4130 powder and how COMSOL Multiphysics is used to simulate SLM process and be able to control processes parameters for this 4310 powder. It is important to demonstrate how to set boundary conditions, control phase change, and capture temperature dependence of thermal physical properties of material in a relatively complex process like SLM.