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Computational analysis of grain structure evolution during selective laser melting

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Development of numerical models to describe crystallization processes taken place during metal additive manufacturing allow one to optimize the process parameters and improve the properties of additive manufactured parts on the one hand as well as deepen the understanding of the microstructural evolution as a whole. We developed two- and three-dimensional grain growth models to describe the evolution of internal structure in a representative volume of additive manufactured material.

The main objective in the development of the grain growth model was to achieve a sufficient computational volume to analyze the effects of the heat source parameters and scanning strategy on the evolution of grain structure and, in the long run, on the mechanical properties of additive manufactured material. As part of the model, a heat source is described explicitly with the use of Goldak double ellipsoid model [2]. Cellular automata approach put forward by Rappaz and Gandin [3] describes grain growth. To minimize the mesh-induced anisotropy, we adopted a decentred octahedron algorithm [3]. The simulation results showed good qualitative agreement with experiment.

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