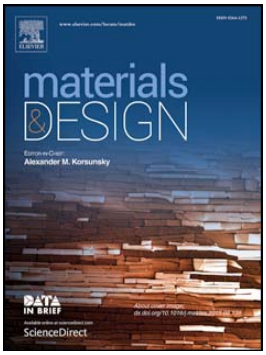

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Geometrical control of lattice structures produced by EBM trough chemical etching : investigations at the scale of individual struts

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Abstract

A major drawback of metal additive manufacturing is the surface roughness of the manufactured components. This is even more critical when complex lattice structures are considered. An octet-truss lattice structure was fabricated by Electron Beam Melting. A chemical post-treatment was applied in order to improve the surface quality. The morphology of individual struts was characterized experimentally by high resolution X-ray tomography after different chemical etching times. The chemical etching treatment was found to be beneficial as it decreases significantly the occurrence of surface defects. The evolution of the elastic mechanical properties with the etching time was determined by FFT computations directly applied to the 3D volume of the struts. A cellular automaton based model was also developed in order to predict the morphological evolution of the as-built strut during etching. The model enables to predict the kinetics of dissolution as well as the evolution of the surface defects and the elastic mechanical properties of the samples. It also enables to determine the required etching time to firstly remove powder particles stuck to the surface and secondly to reduce the plate-pile like defect occurrence.

Keywords: Electron Beam Melting; X-ray Tomography; Cellular Automaton; Lattice Structure; Chemical Etching; Mechanical Efficiency