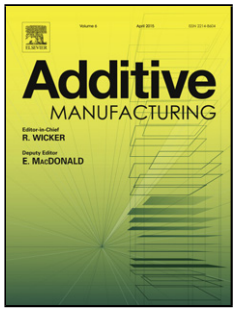

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On characterization of separation force for resin replenishment enhancement in 3D printing

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Abstract

Additive Manufacturing (AM), which is also referred to as 3D Printing, is a class of manufacturing techniques that fabricate three dimensional (3D) objects by accumulating materials. Constrained Surface based Stereolithography is one of the most widely used AM techniques. In the process, a thin layer of liquid photosensitive resin is constrained between a constrained surface and the platform or part. The light penetrates the transparent constrained surface and cures that layer of liquid polymer. Then the platform is moved up to separate the newly cured layer to let new liquid resin fill into the gap and get cured. The separation of newly cured layer from the constrained surface is a grand challenge that limits the printable size and printing speed in this manufacturing technique. Numerous experimental work has been performed to understand how to reduce the separation force in the process. In this paper we study a new design of constrained surface with radial groove texture that significantly influences the effectiveness of reduction of the separation force and hence the manufacturing capability via theoretical modeling. In particular, we investigate an influence of grooves shape, grooves depth and the number of grooves on the separation force. The proposed model is validated with numerical simulations demonstrating an excellent agreement. We demonstrate the possibility of drastic reduction of the separation force (up to 112%) via surface texturing of the permeable window for continuous 3D printing.

Keywords: separation force, Newtonian liquid, constrained surface based

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