Microfluidic Investigations of Capillary Flow and Surface Phenomena in Porous Polymer Media for 3D Printing

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Abstract

The advent of 3D Printing has invigorated research into metamaterials, synthetic composite materials that produce properties generally not found in natural materials, requiring further studies into understanding the fundamental properties of these materials. This dissertation proposes a novel imaging technique to investigate the surface interactions occurring in a packed porous polymeric powder bed experiencing a colloidal fluid penetrating the powder bed, specifically to characterize nanoparticle attachment to polymeric particles. Additionally, Washburn capillary rise studies provide quantitative information about the free energy of a surface, specifically, contact angle. Temperature dependent studies were performed to probe the impact of fluids and polymeric powders interactions in elevated temperatures. An advantage of this novel imaging technique is that the experiment is straightforward, cheap, and time efficient; aptly described as "frugal science."

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