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Fabrication of functional materials with gradient wettability via 3D printing

Control over physical and chemical properties such as porosity and wettability during 3D printing allows for fabrication of functional materials with gradient properties for many applications such as controlled water imbibition and condensation. Common methods for fabrication of functional materials with gradient properties via Digital Light Processing (DLP) 3D printing such as VAT exchange1,2 and gray scale light projection3 have drawbacks like weak interfacial bonding between the layers, and no potential for chemical composition change. In this work, we show a facile method for 3D printing of functional materials with gradient wetting properties. We utilize porogen-induced phase separation (PIPS) for the 3D printing of porous materials4. By altering the resin mixture during the print through addition of an acrylic monomer component, a gradual change in properties and composition of the final structure is achieved. This way, by increasing the hydrophobic or hydrophilic acrylic components, we enhance the hydrophobicity or hydrophilicity in z-direction to achieve a 3D printed porous part with a wettability gradient. By increasing the porogen content during the printing of porous materials we also achieved an increase in pore size along the z-direction. For both cases with gradient chemical or physical properties, the water droplets could be patterned regarding the imbibition, contact angle or wetting state on different area of the 3D printed structure. The versatility of the method allows for alteration of any resin component during the print generating functional materials with gradient wettability upon demand.

References:
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