Engineering Nanostructured Materials via 3D Printing and Polymerization Induced Microphase Separation

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Abstract: Currently, there are no straightforward methods to 3D print materials with nanoscale control over morphological and functional properties. In this talk, a novel approach for the fabrication of materials with controlled nanoscale morphologies using a rapid and commercially available Digital Light Processing 3D printing technique will be presented. The approach uses a controlled/living radical polymerization technique, more specifically, reversible addition-fragmentation chain-transfer (RAFT) polymerization, to control the topologies of the polymers.[1-2] In this talk, we report a rapid visible light mediated polymerization process and applied it to a 3D printing system.[3] Following the optimization of the resin formulation, a variety of 3D printing conditions will be presented to prepare functional materials.[4] The mechanical properties of these 3D printed materials were investigated under different conditions, showing that the control of the polymer structure can affect the performance of these materials.[5] Furthermore, the polymer networks were able to be reactivated after the initial 3D printing process, which allowed the post functionalization of the printed materials via secondary photopolymerization processes, enabling to introduce information.[6] Finally, by controlling the polymer architecture, we were able to precisely control the nanostructure of these 3D printed materials via a polymerization induced microphase separation.[7] The effect of nanostructure on 3D printed material properties will be discussed as well as their potential applications in drug delivery and energy storage, such as their use as solid polymer electrolytes for supercapacitor application.

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