

Design of functionalized polyarylene ether sulfones for stereolithographic printing

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Vat photopolymerization (VPP) is an advanced additive manufacturing technique that allows for the production of intricate 3D assemblies that are unable to be matched by traditional manufacturing methods. VPP was targeted as the preferred method for 3D printing high temperature thermoplastics due to its high modularity and selectivity of UV exposure. In this work, modifications of polyarylene ether sulfones (PSU) formulations allows for VPP processing. Telechelic functionalization with acrylates across various molecular weights (6KDa, 10KDa, 15KDa) of PSU yielded photo-crosslinkable polymers. Addition of diphenyl(2,4,6-trimethylbenzoyl)phosphine oxide (TPO) photo-initiator to the solution of PSU in N-methylpyrrolidone (NMP) at 20 wt % produces a vat photopolymerizable resin. The relationship between photoinitiator concentration and acrylate conversion along with the storage/loss modulus crossover time was investigated through variations of the photoinitiator concentration. These studies displayed that the concentration of photoinitiator and crossover time share an inverse relationship therefore the highest loadings of TPO yield the fastest crossover times, which is important for determining the viability of a materials use for VPP as a fast crossover time is essential for the printed parts to retain their shape. Photorheology studies of the molecular weight and TPO loading series identified the 6KDa PSU as the best sample for VPP. The addition of 0.5 wt% of avobenzene photoblocker produced a well-defined print with 6KDa PSU. For higher molecular weights (>12KDa), a small molecule crosslinker was added to increase the acrylate concentration thereby producing an organogel with a modulus sufficient for stereolithography.

