



Vat Photopolymerization of Acrylate-based Plastic Scintillators

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Abstract:

Digital light projection or stereolithography vat photopolymerization is an additive manufacturing printing technique where light is used to initiate polymerization in a layer-by-layer process. Acrylate-based plastic scintillators have been targeted for printing using this process, but the fluorophores used in plastic scintillators can inhibit the process by absorbing the active photons. The impact of multiple fluorophores on both printing and scintillation is characterized. 2,5-diphenyloxazole (PPO), in quantities up to 25 wt% of the resin, showed little effect on print parameters such as light penetration depth and critical energy dose. Three secondary fluorophores were also examined, having significant impacts on print parameters at only 0.1 wt%. Scintillation performance was evaluated in terms of light output and pulse shape discrimination metric, with printed scintillators achieving light outputs as high as 3,000 photons/MeV and FoM around 1.3. The selection of fluorophores in a scintillator precursor resin must be carefully considered for both detector performance and printing requirements when designing resins for additive manufacturing.