**Tailoring Bio-based Polyester UV-curable Resins with Tunable Mechanical Properties suitable for SLA 3D Printing Applications**

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**Abstract:**

Stereolithography (SLA) 3D printing enables high-resolution, complex structures, but mechanical properties are often limited by the resins. This study focuses on developing and characterizing renewable polyester resins to optimize mechanical properties for SLA printing. Bio-based polyester resins were synthesized via polycondensation of diacids (itaconic, succinic) and diols (1,2-propanediol, 1,4-butanediol, 1,8-octanediol). The renewable nature provides advantages over petroleum-derived resins; diacid and diol monomers come from feedstocks like corn and soy rather than finite fossil fuels. This increases sustainability and diversifies chemical structures to modify resin properties. Effects of diacid structure and diol chain length on resin properties were investigated. NMR and FTIR suggested successful polyester synthesis. By varying building blocks, molecular weight, crosslink density, and mechanics were tailored. Rheology confirmed shear-thinning behavior ideal for SLA. Mechanical testing revealed tunable tensile strength (2.0 -0.2 GPa) and elongation at break (1.9-7.3%) via differing components. Printability was assessed by printing a resolution test piece on an SLA printer with 405nm UV. The tailored renewable polyester resins can be used to 3D print high-strength bone implants for tissue engineering applications. The ability to tailor resin properties by molecular design enables high-performance SLA-printed objects, from prototypes to end-use products.