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Biocompatible UV-Curable Acryl-Polyurethane for 3D Printing Architectures

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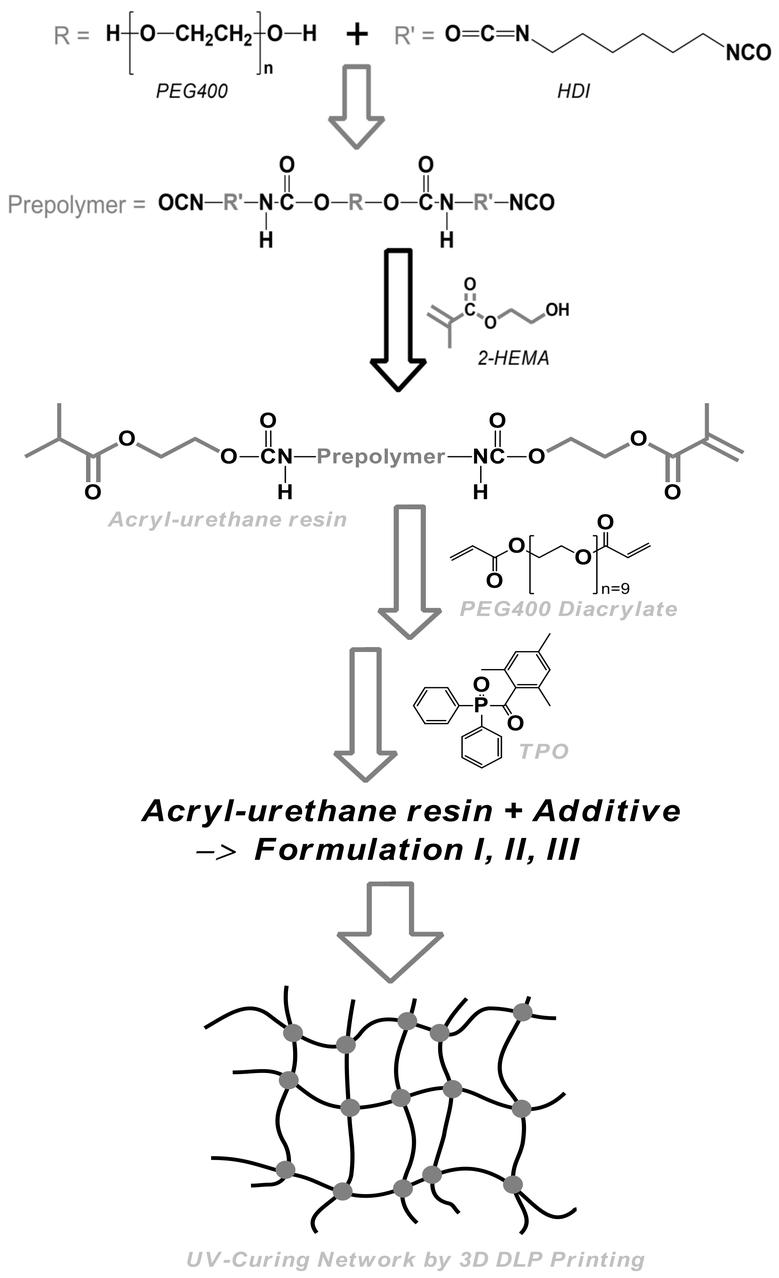
Abstract

Acrylic functionalized urethane prepolymer series of various compositions were designed with high biocompatibility by cytotoxicity evaluation with polyethylene glycol (PEG) and hexamethylene diisocyanate (HDI). After that, acryl-urethane resin (AU) was synthesized by attaching 2-hydroxyethyl-methacrylate (2-HEMA) and used for digital light processing (DLP) 3D printing by adding photo-initiator and additive acrylate. When the acryl-urethane resin/base acrylate ratio was 1/9, the UV cured acryl-polyurethane (APU) formulations had the excellent mechanical properties and highest resolution. The materials were characterized by Fourier transform infrared (FT-IR) spectroscopy, UV absorbance, viscous properties, optical microscope, field emission scanning electron microscopy (FE-SEM), mechanical properties, and cell viability method. Overall, this UV-curable AU resin can be a promising prepolymer for the DLP printing of flexible photo-resin for biocompatible and photo-curable applications.

Objective

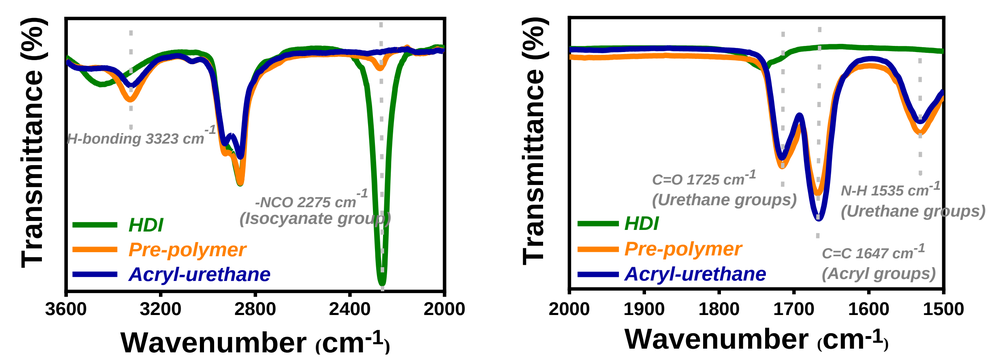
1. **To synthesize a novel acryl-urethane resin for DLP 3D printing.**
2. **To evaluate the mechanical properties and biocompatible of 3D printing architectures.**
3. **To provide the advances in the cytotoxicity of an acryl-urethane resin, as well as innocuous formulation into bench-scale product.**

Experimental

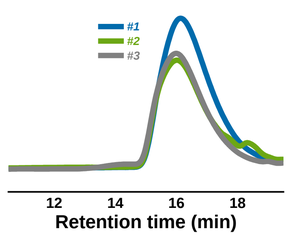


Results

FT-IR

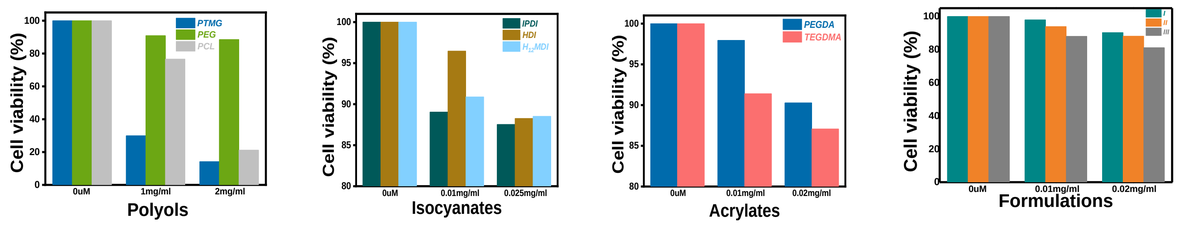


GPC

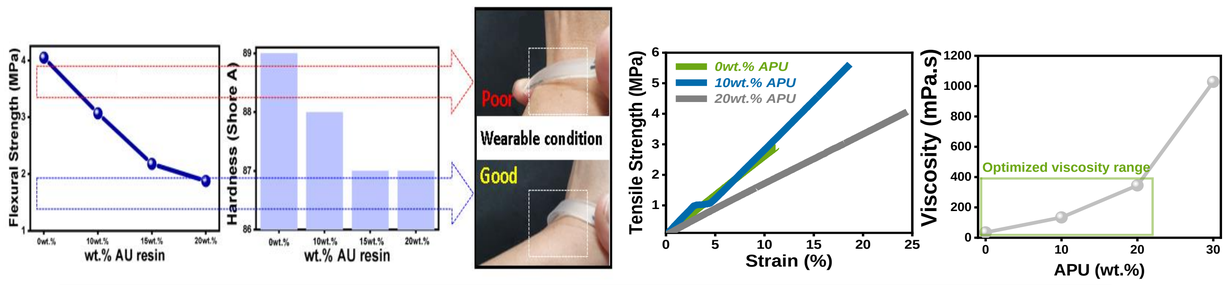


	M_n	M_w	PDI
Acryl-urethane #1	16073	26022	1.6
Acryl-urethane #2	16690	27004	1.6
Acryl-urethane #3	15316	24126	1.6

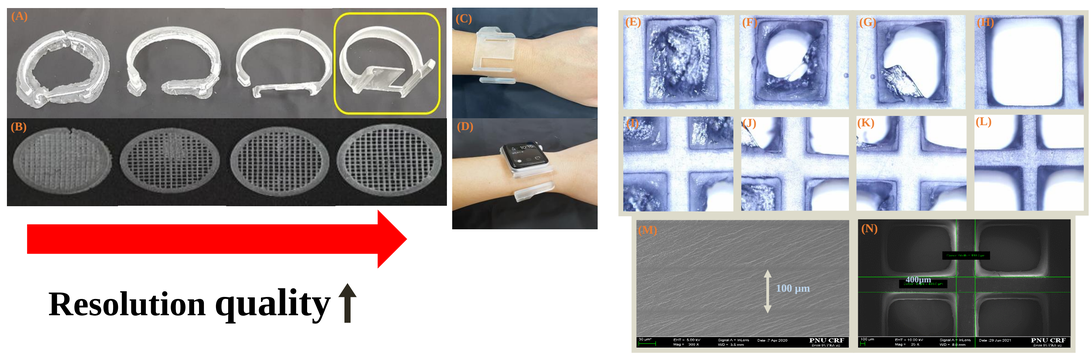
Cell viability



Mechanical Properties



	Viscosity (mPa.s)	Stress (MPa)	Strain(%)	Hardness (Shore A)	Flexural Strength (MPa)
0 wt. %	35.2	2.89	11.13	89	4.05
10 wt. %	134.1	5.62	18.67	88	3.07
20 wt. %	345.3	4.06	24.48	87	1.88



Conclusion

▶ When the acryl-urethane resin/base acrylate ratio was 1/9, the UV cured acryl-polyurethane (APU) formulations had the excellent mechanical properties and highest resolution.

▶ This UV-curable AU resin can be a promising prepolymer for the DLP printing of flexible photo-resin for biocompatible and photo-curable applications.

Acknowledgement

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