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Synthesis and properties of photo-curing PU-acrylate through short curing time

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Abstract

Thermoplastic photo-activating PU was successfully synthesized by the additional reaction of methylene diphenyl diisocyanate (MDI), poly(tetramethylene ether) glycol, and tri-acrylate derivatives as a crosslinking point. The crosslinked PU-acrylate elastomers were fabricated by the exposure to 200~400μm UV radiation. DMF was used as a solvent for the synthesis, but THF with low UV cut off was used to crosslinked the PU-acrylate in order to reduce crosslinking time. The structures and properties of the resulting acryl-PUs were evaluated by fourier transform infrared spectroscopy (FT-IR), gel permeation chromatography (GPC), ultra violet spectroscopy (UV-Vis), differential scanning calorimetry (DSC), and universal testing machine (UTM). The increase of acrylate concentration in acryl-PUs elastomers led to higher tensile strength and hardness due to the increased crosslinking density and the enhanced interchain hydrogen bonding. The application as a 3D printing material was verified according to the shortened crosslinking time.

Objective

1. To synthesize a Acryl-PU series composed of PTMG as a polyol and acrylate and MDI as an isocyanate

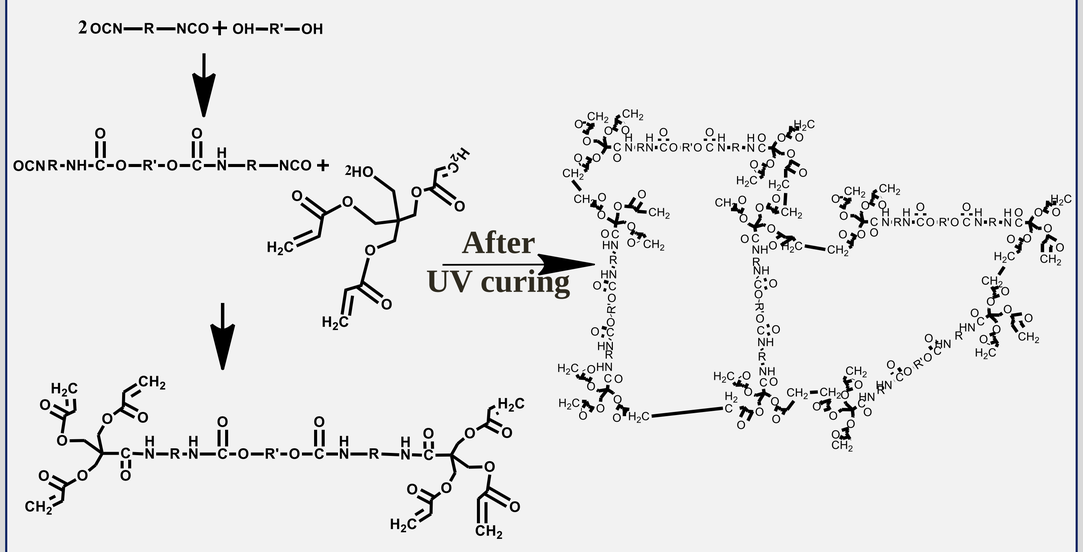
2. To evaluate the physical properties and reduce the photo -curing time of Acryl-PUs

3. To compare the film as the UV curing progress

Preparation of PU with Acrylate

- High mechanical properties compared to the conventional 3D Printer Materials
- Reduce the photo-curing time using acrylate type and content
- Check the physical & chemical properties as the UV curing progress

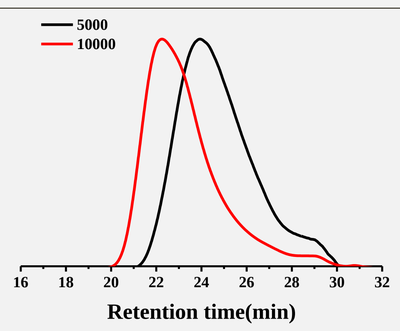
Experimental



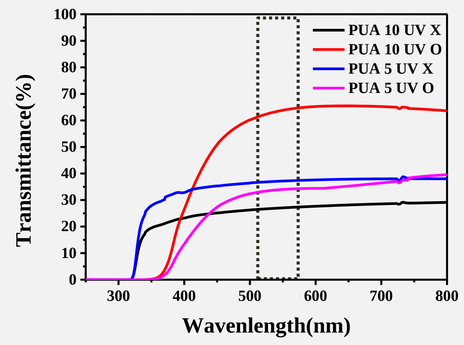
Results

GPC

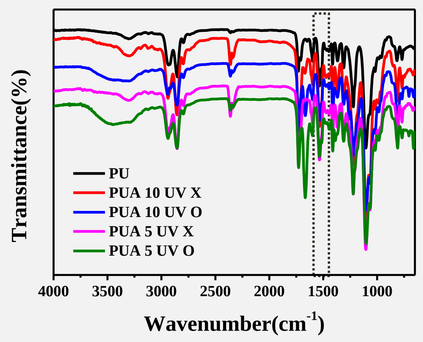
	M_n	M_w	PDI
PUA 5	5257	11330	2.15
PUA 10	10200	27320	2.67

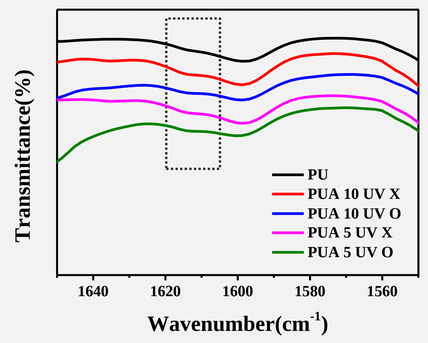


UV Transmittance

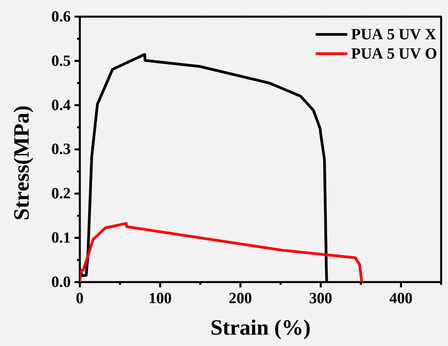


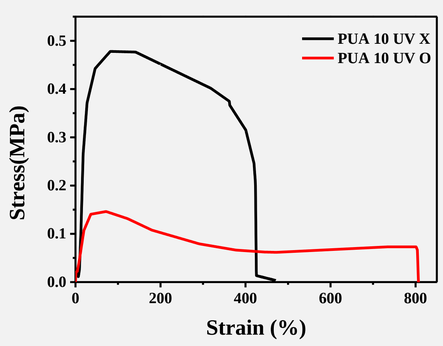
FT-IR





UTM

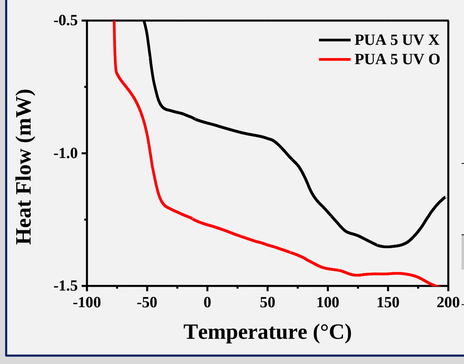




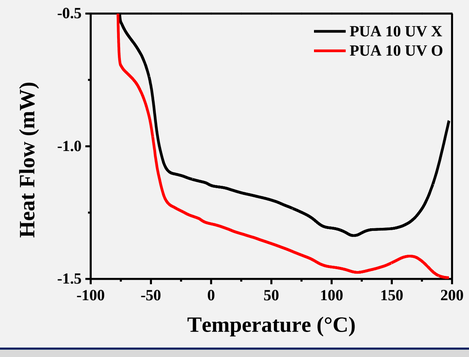
	Stress (MPa)	Strain(%)	Young's Modulus (MPa)
UV X	0.51350	291.278	4.6590
UV O	0.13117	343.127	0.0058

	Stress (MPa)	Strain(%)	Young's Modulus (MPa)
UV X	0.47799	401.197	4.6590
UV O	0.14607	804.029	0.0056

DSC



	ΔH_m(J/g)
UV X	1.726
UV O	0.9635



	ΔH_m(J/g)
UV X	1.716
UV O	1.101

Conclusion

- The successful synthesis Acrylate-PUs and UV-cured by the photo-initiator
- The special optical properties of the PUA after UV-curing (UV transmittance : 25 to 65%)
- The increase of percentage strain and decrease of tensile strength & Young's modulus after UV-curing
- To demonstrate potential applications of 3D printer materials

Acknowledgement

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