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Synthesis and properties of UV-curable Acryl-Polyurethane for high-rate curing

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Abstract

Thermoplastic UV-curable PU was successfully synthesized by the addition of diacrylate as a crosslinking point. The crosslinked PU-acrylate elastomer was formed by the short exposure to 300~400μm UV radiation. The effect of diacrylate type and concentration on the physical properties was evaluated using UTM, UV spectrometer and SEM. The increase of diacrylate concentration in PU-acrylate elastomer led to higher tensile strength and hardness due to the increased crosslinking density. The optimized compatibility of PU and diacrylate strongly depended upon the type used of diacrylate.

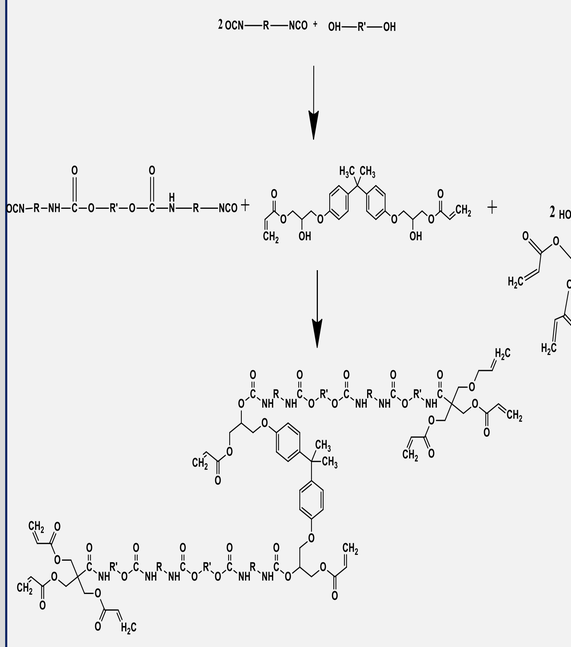
Objective

1. To synthesize a PU-Acrylate series composed of PTMG as a polyol and Acrylate content and MDI as an isocyanate
2. To evaluate the physical properties and reduce the photo -curing time of PU-Acrylate.
3. To compare the film as the UV curing progress

Preparation of PU with Acrlyate

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

Experimental



Step 1 methylene diphenyl diisocyanate + poly(tetramethylene ether) glycol

Step 2 Addition of hard segment

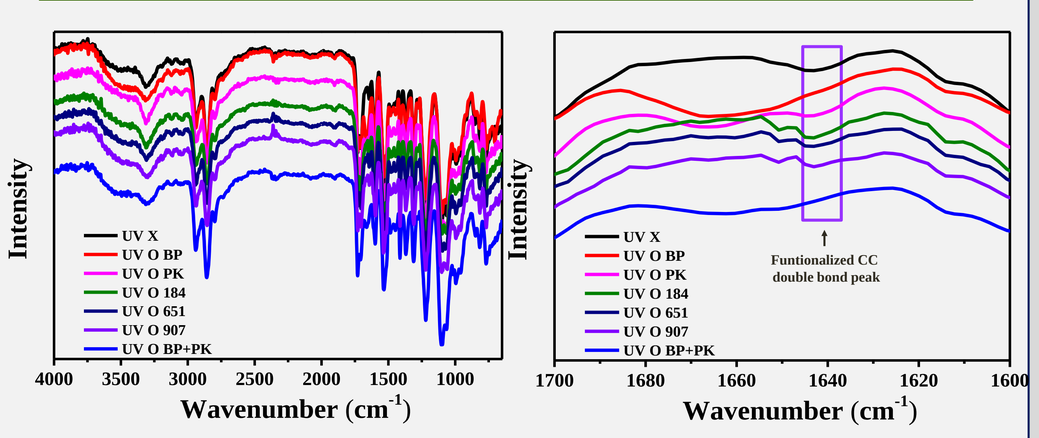
Step 3 Addition of the acrylate

Step 4 Transfer to designated container

Results

Photo-initiator Type
Benzophenone
Penylketone
Irgacure 184
Irgacure 651
Irgacure 907
Benzophenone + Penylketone

FT-IR



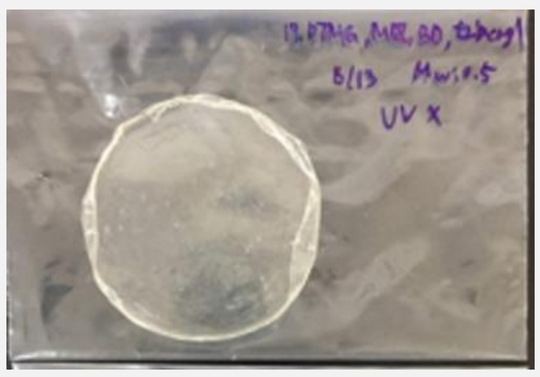
Physical Cross-link Density

Weight \ Initiator	BP	Irgacure 184	Irgacure 651	Irgacure 907	BP+PK
Weight after drying (g)	0.0364	0.0203	0.0303	0.0337	0.0354
Weight after swelling (g)	0.0989	0.0685	0.0939	0.1043	0.1237
Gel content (%)	36.80	29.64	32.27	32.31	28.62

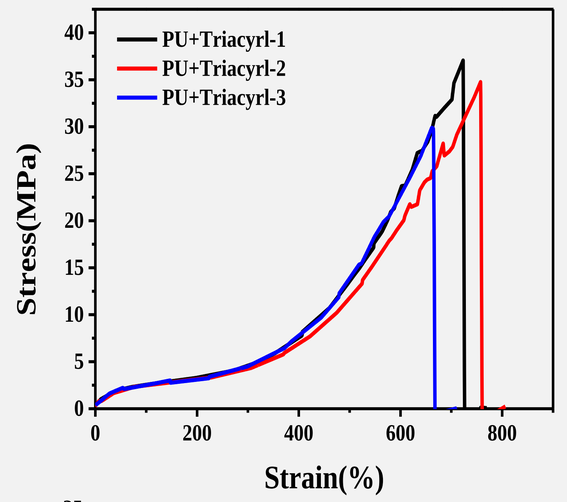
Chemical Cross-link Density

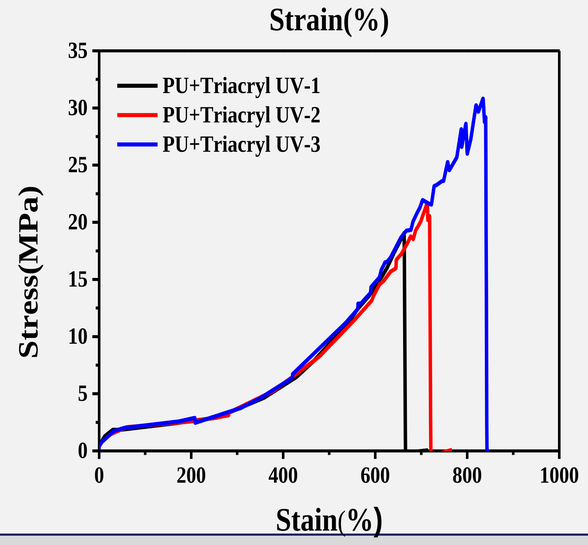
Weight \ Initiator	BP	Irgacure 184	Irgacure 651	Irgacure 907	BP+PK
Weight after drying (g)	0.0447	0.04	0.0768	0.0628	0.045
Weight after swelling (g)	0.5524	X	X	X	X
Gel content (%)	8.09	--	--	--	--

PU-Acrylate film photo



UTM





Conclusion

- The successful synthesis PU-Acrylate and UV-cured by the photo-initiator
- Only benzophenone affected to radical reaction as a photo-initiator
- The increase of acrylate concentration in PU-acrylate elastomer led to higher tensile strength and less Young's modulus due to the increased crosslinking density.

Acknowledgement

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