

# Fabrication of 3D Printer material by controlling curing time of Polyurethane

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## Abstract

The intrinsic viscosity of the photo-curable monomer and polymer is measured to target the molecular weight of the material. The photo-curing polymer is produced through physical or chemical reaction, and the curing time and physical properties of the material are adjusted according to the purpose. It can be controlled the ratio of the photo initiator and urethane. For example, Thermoplastic polyurethane (TPU) series based on poly(tetramethylene glycol) (PTMG1000) as a polyol and methylene diphenyl diisocyanate (MDI) as a isocyanate were synthesized as a function of molecular weight formulation. After that, it is photo-cured by attaching acrylate, and it is designed by applying UV through hydrogel type 3D printing.

## Objective

1. To synthesize a PU-Acrylate products composed of PTMG as a polyol and MDI as an isocyanate and acrylate content
2. To evaluate the physical properties and reduce the contents of isocyanate of PU-Acrylate
3. To compare the viscosity of PU-Acrylate

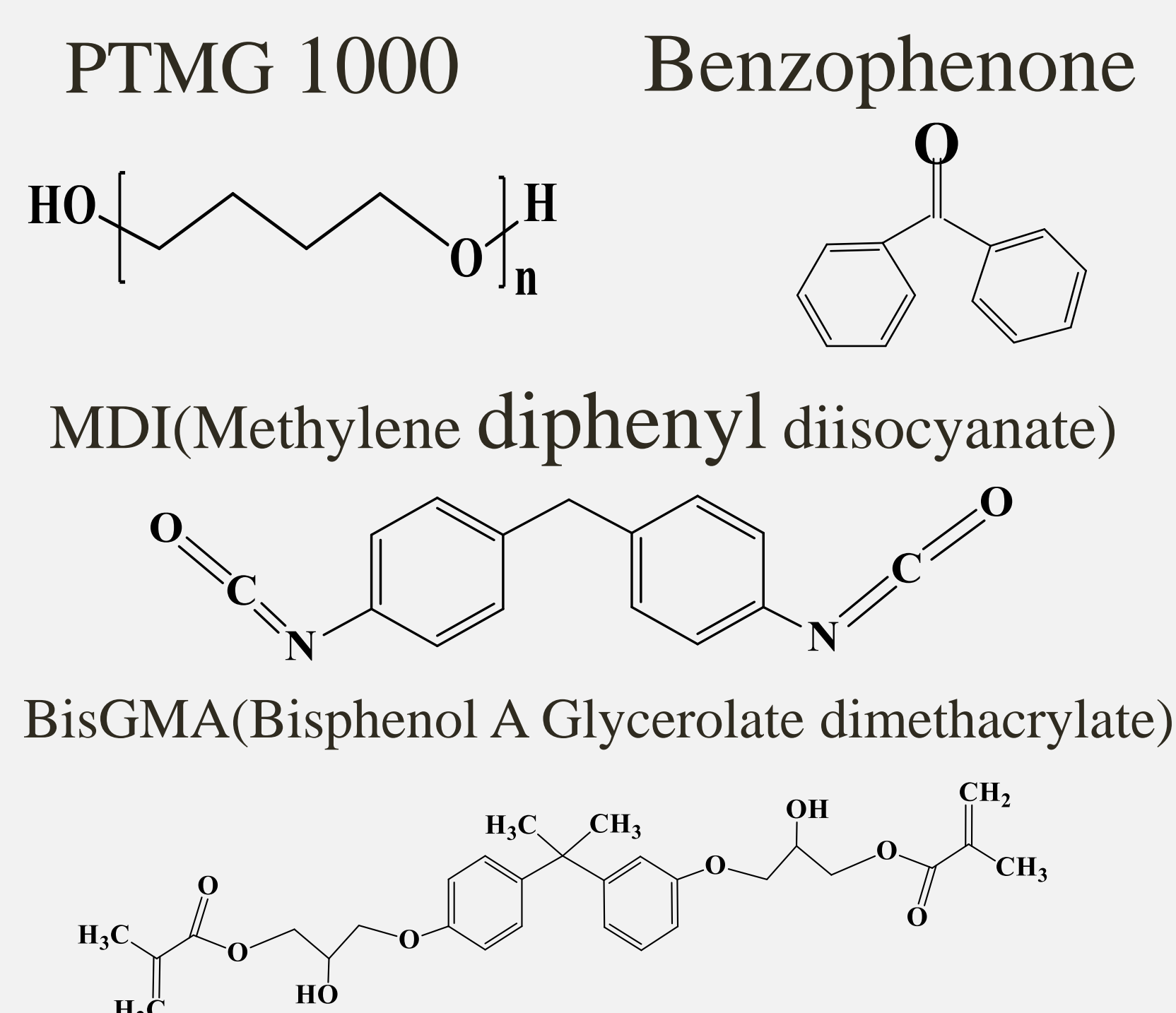
Synthesize of Polyurethane with Acrylate

High mechanical properties compared to the conventional

Reduce the photo-curing time used by acrylate ratio

Apply to future 3D Printer due to viscosity control

## Materials



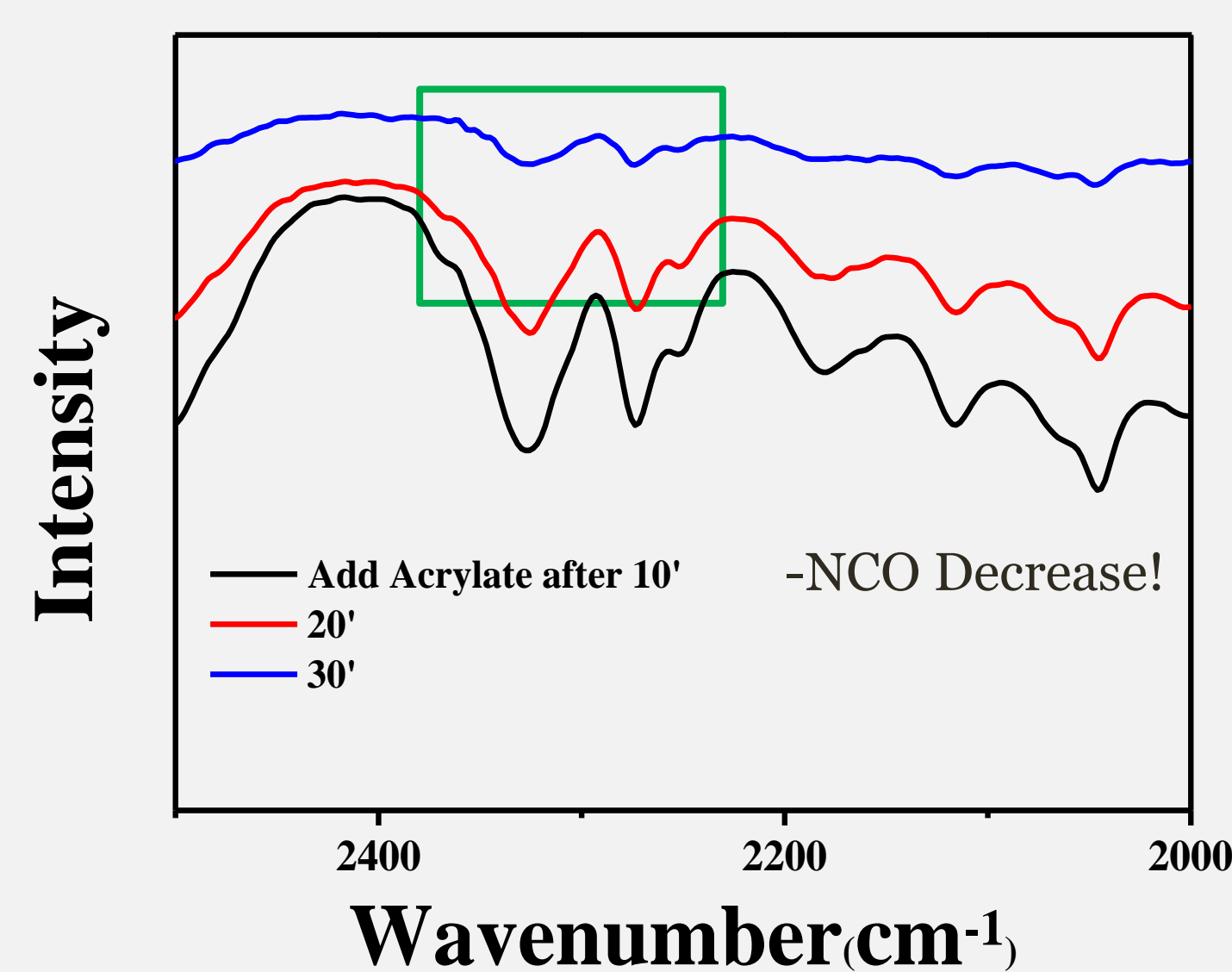
## Experimental

### SCHEME

- Step 1 Poly(tetramethylene glycol)1000 + MDI(methylene diphenyl diisocyanate)
- Step 2 Addition of bis GMA
- Step 3 Addition of MDI for hard segment
- Step 4 Addition of Benzophenone

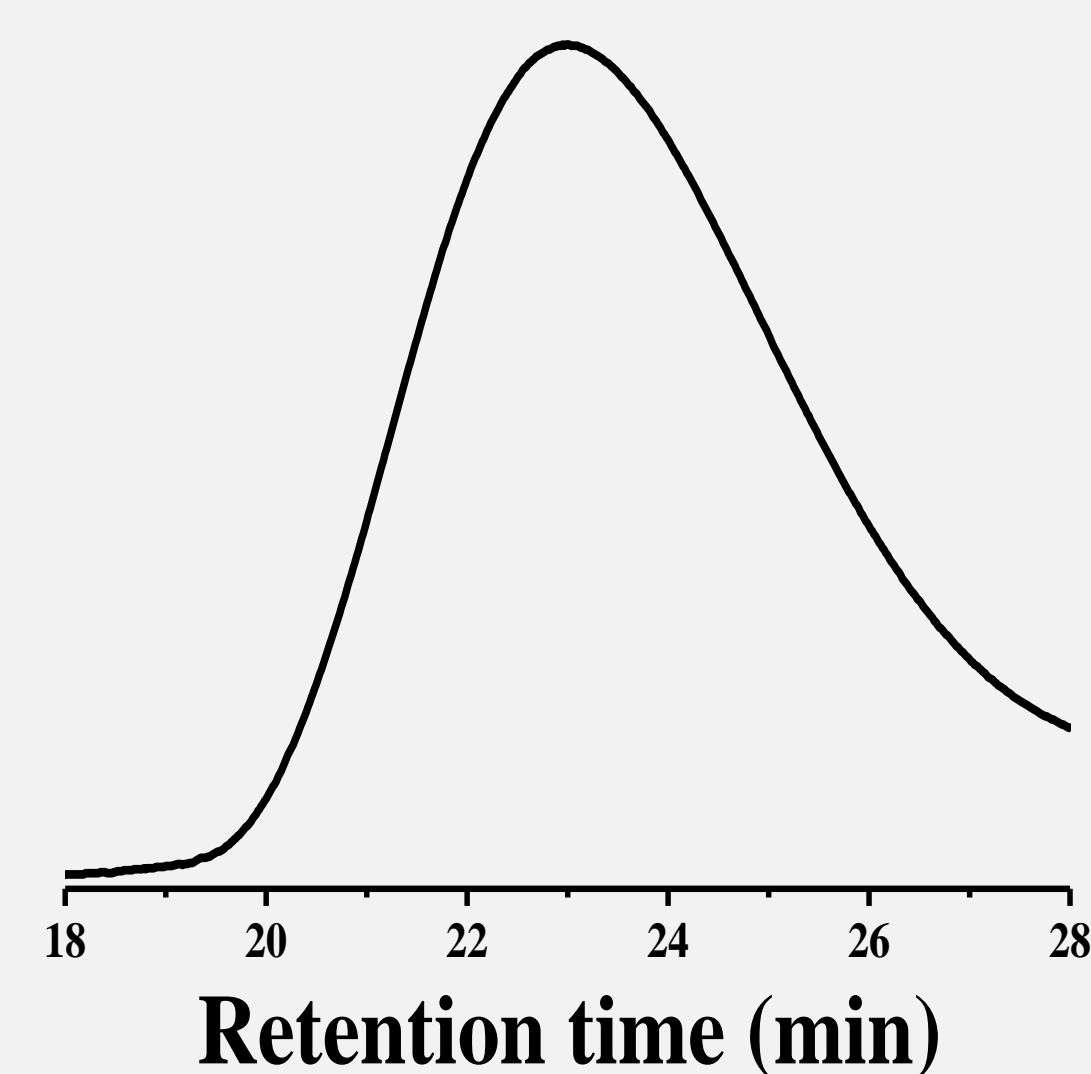
## Results

### FT-IR



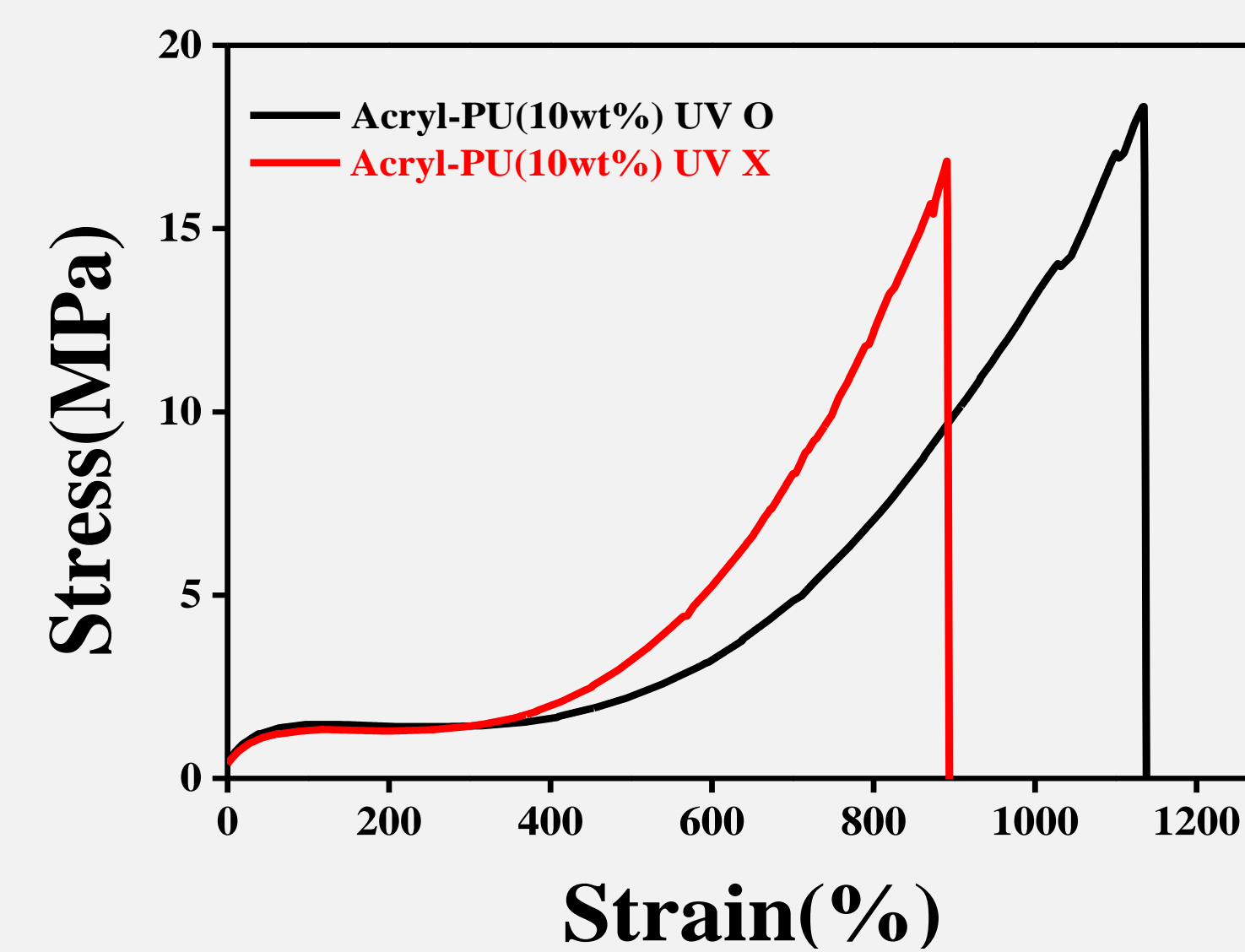
Characterization peak	Wave length(cm <sup>-1</sup> )
-NCO(Isocyanate)	2270

### GPC



$\bar{M}_n$	$\bar{M}_w$	Polydispersity
13915	23761	1.707570

### UTM



	Young's Modulus (Mpa)	Maximum Stress (Mpa)	Percent Strain(%)
UV O	5.2868	18.335	1135.3
UV X	7.4429	16.869	891.3

### VISCOSITY

SAMPLE	VISCOSITY
PU-ACRYL	2348mPa.s
PHOTO INITIATOR 1wt%	2850mPa.s
PHOTO INITIATOR 5wt%	6591mPa.s
PHOTO INITIATOR 10wt%	7490mPa.s



CONDITION	
SHEAR RATE	50s <sup>-1</sup>
DURATION	60sec

## Conclusion

- The successful synthesis PU-Acrylate and UV-cured by the photo-initiator
- The mechanical properties(stress, strain) are increased by UV-curing ( Stress : 16.869Mpa  $\longrightarrow$  18.335Mpa, Strain : 819.3%  $\longrightarrow$  1135.3% )
- Measure the suitable amount and viscosity of initiators for use in 3D printer

## Acknowledgement

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