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Fabrication of 3D Printer material through Optimizing of Viscosity and UV Curing time

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Abstract

The intrinsic viscosity of the photo-curable monomer and polymer is measured by blend ratio 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 polymer. For example, Thermoplastic polyurethane (TPU) series based on polyethylene glycol (PEG) as a polyol and hexamethylene diisocyanate (HDI) as a isocyanate were synthesized as a function of molecular weight formulation. After that, PEG di-acrylate series based on polyethylene glycol (PEG) and acrylate blend were used for DLP (Digital Light Processing) 3D printing. In this experiment used two kinds of initiators to control. After that, it is output according to the photo-curing time adjustment.

Objective

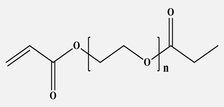
1. **Blending PU and Acrylate contents to make a PU-Acrylate products**
2. **Evaluation the physical properties and comparisons according to curing time difference**
3. **To compare the viscosity of PU-Acrylate blend**

Blending of PU with Acrylate

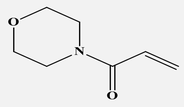
- **High mechanical properties compared to the each other**
- **Reduce the photo-curing time used by acrylate ratio**
- **Apply to future 3D Printer due to viscosity control**

Materials

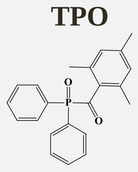
PEG-Diacrylate



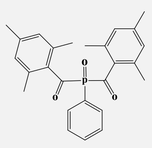
Acryloyl Morpholine



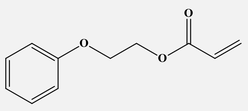
TPO



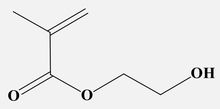
IRGACURE 819



2-Phenoxyethyl Acrylate



HEMA



Experimental

Step 1 Synthesis of Polyurethane

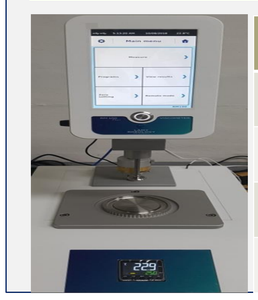
Step 2 Blend with PU and Acrylate

Step 3 Addition of Photoinitiator

Step 4 Adjust to proper viscosity for DLP method

Step 5 Adjust to Curing time control

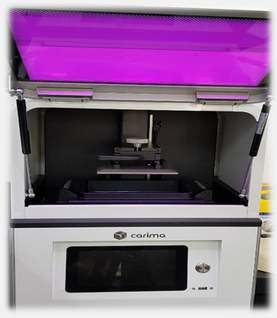
VISCOSITY



SAMPLE	VISCOSITY
Blend TYPE A + TPO	27595mPa.s
Blend TYPE A + 819	28626mPa.s
Blend TYPE B + TPO	30082mPa.s
Blend TYPE B + 819	28411mPa.s

CONDITION	
SHEAR RATE	$50s^{-1}$
DURATION	60sec

Results



1. **Used by Carima DLP 3D printer**
2. **Printed it out by controlling the curing time**
3. **SEM images were taken at 100 and 500 times the surface and side laminated areas**

SAMPLE

A Type + 819

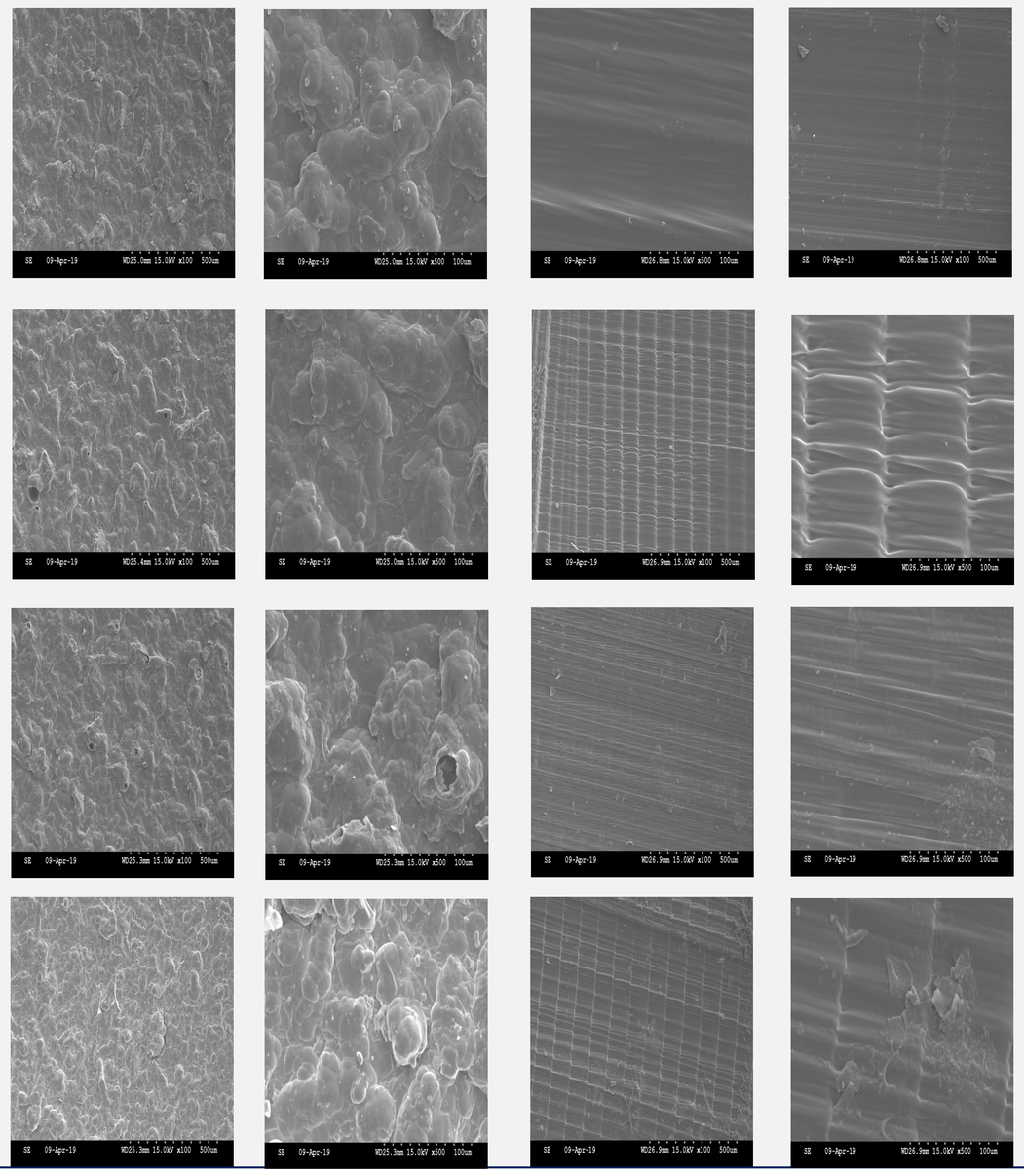
A Type + TPO

B Type + 819

B Type + TPO

SEM IMAGE

Surface | **Side**



Conclusion

- **The successful fabrication PU-acrylate blend and UV-cured by the photo-initiator**
- **As a result of SEM imaging, it was confirmed that the side lamination was better when TPO initiator was used.**
- **With the appropriate viscosity and blend ratio, we have successfully produced printouts using 3D printer.**

Acknowledgement

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