한국고분자학회
The Polymer Society of Korea

2022 춘계 고분자 학회
April 6 – 8, 2022

Synthesis of Isosorbide-Based Polyurethane for Moisture Barrier Film with Different Polyols and Soft-Hard Segments Ratio

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Abstract

A series of isosorbide-based thermoplastic polyurethanes (TPUs) with different soft/hard ratios but the similar molecular weight were successfully synthesized by step-polymerization using two types of polyols. polycaprolactone diol (PCL) or polytetramethylene glycol (PTMG), and methylene diphenyl diisocyanate (MDI) as the soft segment, and bio-based material isosorbide (ISB) for chain extender and MDI as hard segments. The ratio of soft/hard segments consisted of weight fractions of 6/4 and 9/1, respectively. The structure of the polyurethane series was analyzed by fourier transform infrared spectroscopy (FT-IR) and gel permeation chromatography (GPC). The thermal properties were analyzed by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). TPUs films with high hard segment ratios indicated lower water vapor permeability. Although hydrophilic isosorbide was used in polyurethane, water vapor permeability could be adjusted by structural differences.

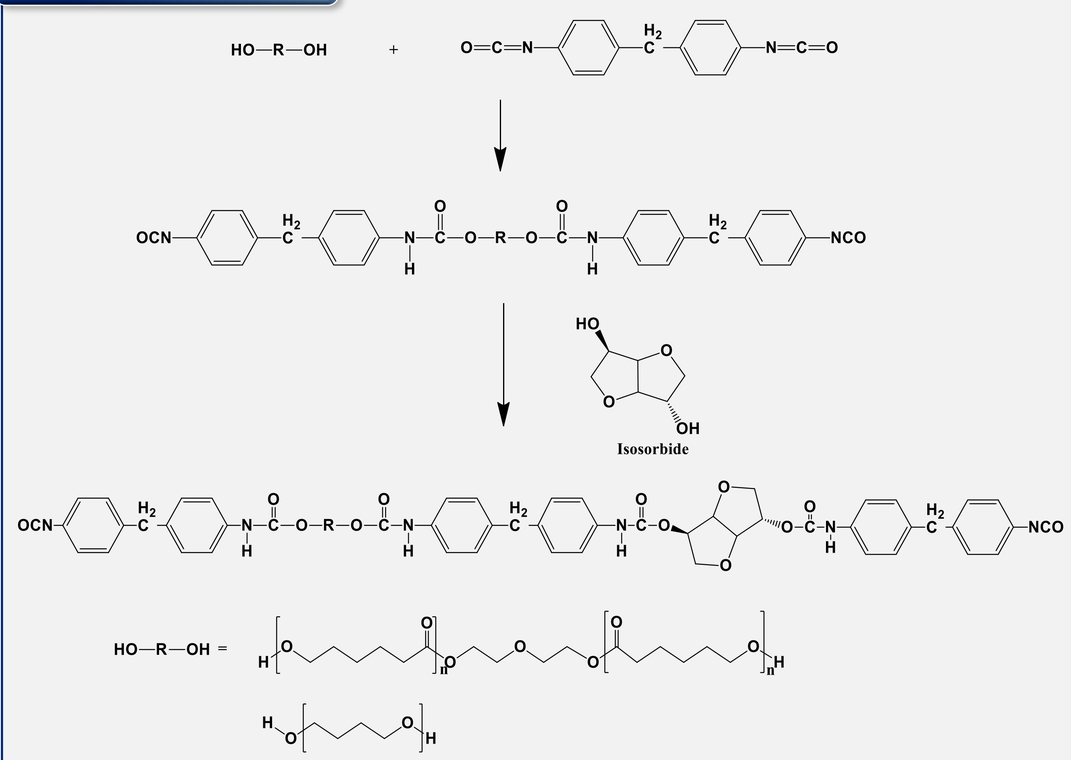
Objective

1. To synthesize ISB-PU series composed of PTMG or PCL as the polyol and MDI as the isocyanate and ISB as the chain extender.
2. Comparison of characteristics according to polyol and soft/hard segment ratio.
3. Decrease in water permeability to protect electronic devices from moisture of bio-based polyurethane with controlled soft/hard segment ratio.

Preparation of PU with different soft/hard segments ratio

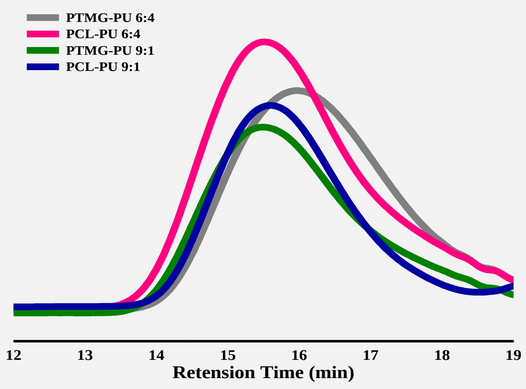
- Check mechanical & thermal properties with various analysis method
- Observation of correlation between soft/hard segment ratio and water vapor permeability
- Properties that change the degree of hydrogen bonding depending on the structure of the polyol

Experimental



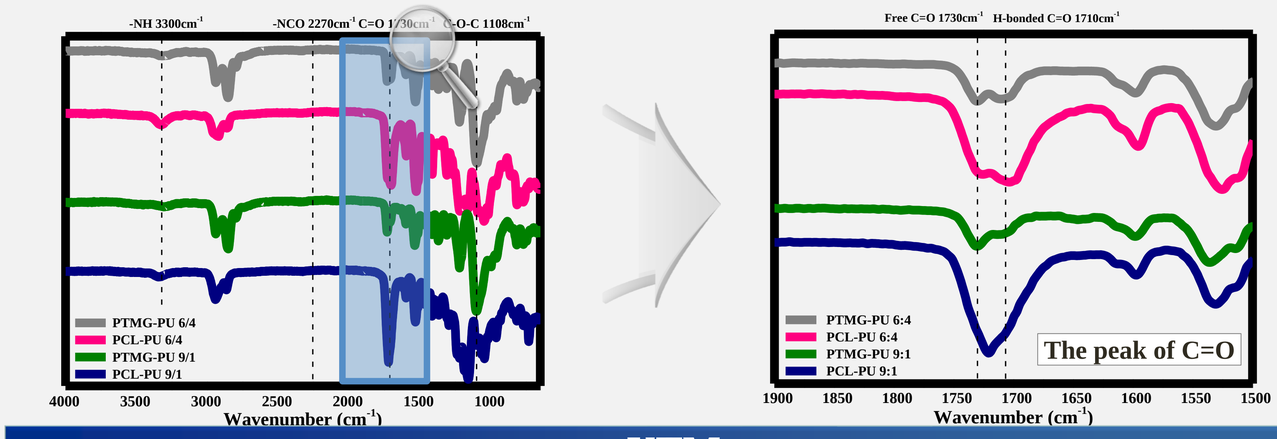
Results

GPC

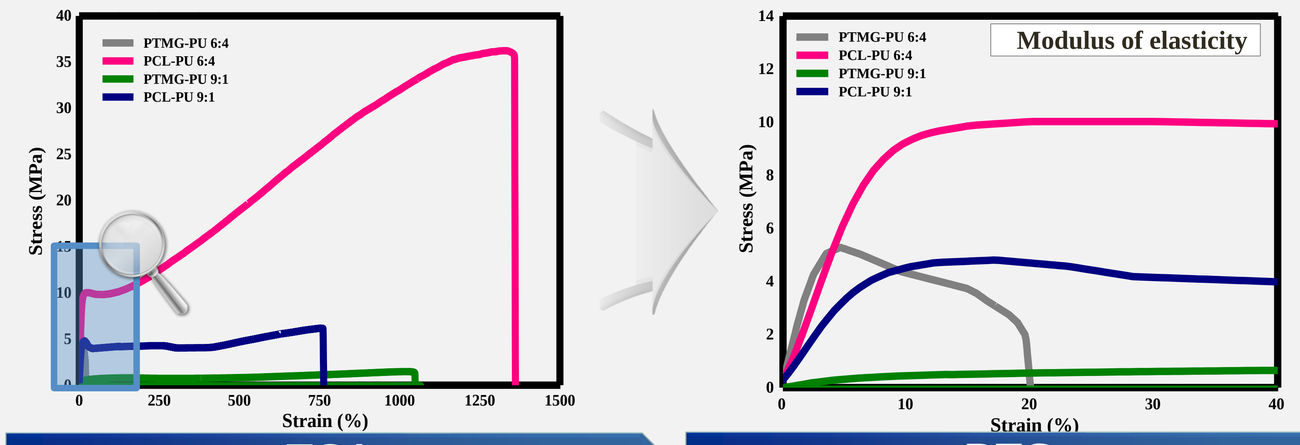


Sample Code	Average Molecular Weight		
	Mn (g/mol)	Mw (g/mol)	PDI
PTMG-PU 6/4 (PU-1)	15,821	31,301	1.97
PCL-PU 6/4 (PU-2)	17,860	41,946	2.35
PTMG-PU 9/1 (PU-3)	20,695	42,678	2.06
PCL-PU 9/1 (PU-4)	20,692	38,779	1.87

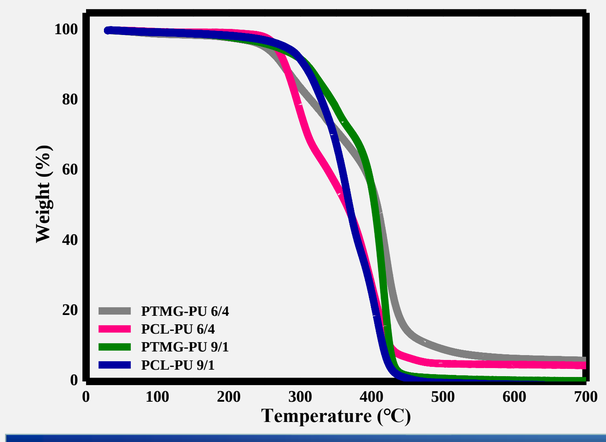
FT-IR



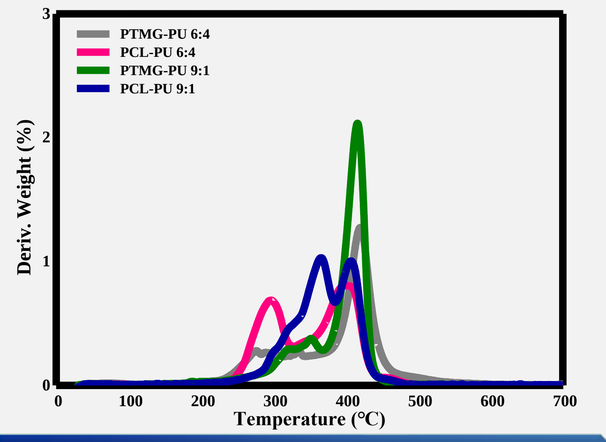
UTM



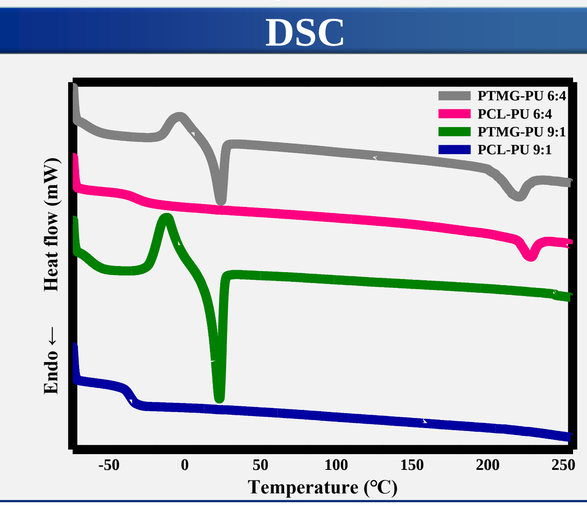
TGA



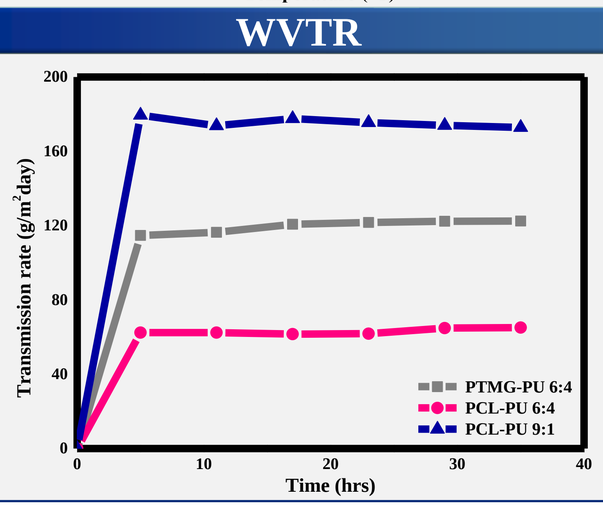
DTG



DSC



WVTR



Conclusion

- The successful synthesis ISB-Pus with controlled soft/hard segment ratios
- ISB-PUs decreased water permeability successfully to increase hard segment ratio
- Although ISB is hydrophilic, the water permeability can decrease with the increase of the hard segment

Acknowledgement

This work was supported by Industrial Strategic Technology Development Program (Bio tackifier adhesive material with a biomass content of 50% or more, 20010807)