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Synthesis and characterization of eco-friendly thermoplastic polyurethane material based on biomass Isosorbide

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Abstract

Thermoplastic polyurethanes (TPUs) were successfully synthesized using in-situ condensation polymerization based on poly(tetramethylene ether) glycol and methylene diphenyl diisocyanate (PTMG-MDI) as soft blocks and eco-friendly isosorbide (ISB) chain extender as hard blocks. The differences in molecular weight (650, 1000, 2000g/mol) of polyol significantly affected the thermal properties. Various properties were evaluated by Fourier transform infrared spectroscopy (FT-IR), gel permeation chromatography (GPC), universal testing machine (UTM), differential scanning calorimetry (DSC). ISB-PU exhibited high mechanical properties for high functional plastic applications in eco-friendly products fields.

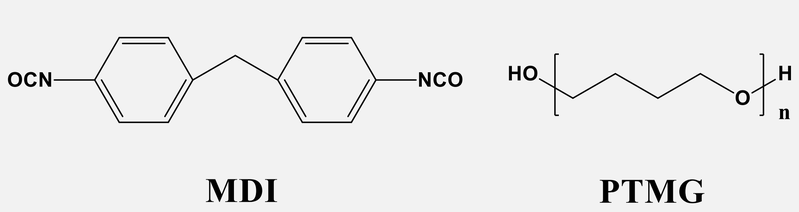
Objective

1. **To synthesize ISB-PU series composed of PTMG as the polyol, MDI as the isocyanate and Isosorbide as the chain extender.**
2. **Comparison of ISB-PU characteristics according to various molecular weight of polyol.**
3. **To evaluate the mechanical properties and thermal properties.**

Preparation of ISB-PU with different molecular weight of polyol

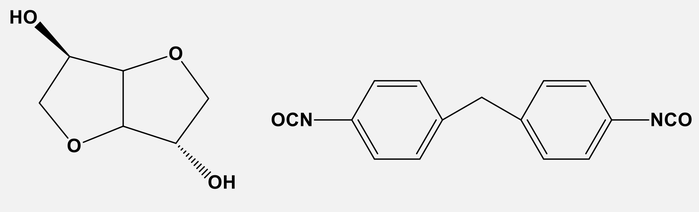
- **Check mechanical & thermal properties with various analysis**
- **ISB-PU from low molecular weight polyol doesn't exhibit high mechanical properties**
- **Using of the high molecular weight polyol indicates the low temperature flexibility of the ISB-PU**

Experimental



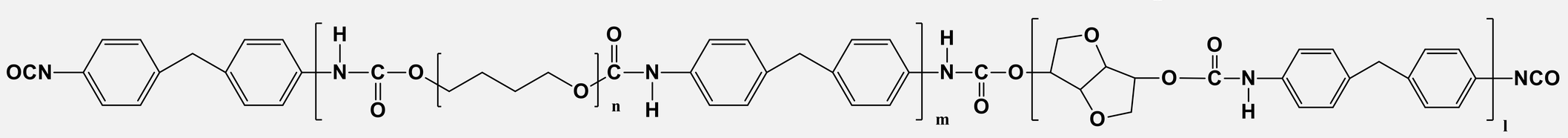
MDI **PTMG**

Soft Segments



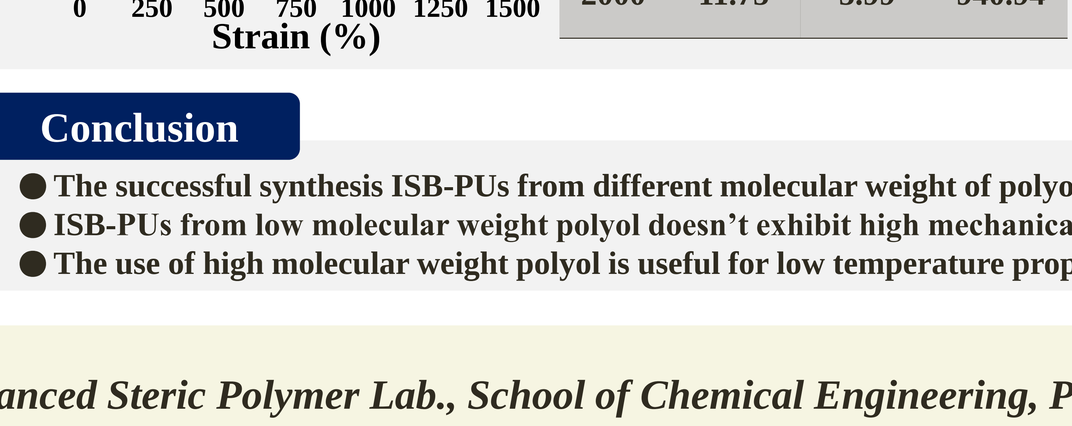
Isosorbide **MDI**

Hard Segments

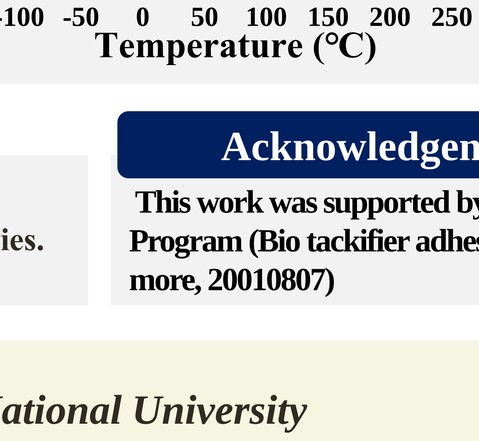


Results

FT-IR



GPC



Polyol MW	M_n	M_w	PDI
650	41,963	76,425	1.82
1000	39,891	98,956	1.91
2000	38,687	70,240	1.82

UTM

Polyol MW	Young's Modulus (MPa)	Max Stress (MPa)	Max Strain (%)
650	8.31	3.49	1048.90
1000	6.19	10.46	1298.50
2000	11.75	5.99	940.94

DSC

Polyol MW	T_g(℃)	T_m(℃)
650	-21.661	-
1000	-43.402	-
2000	-68.767	14.946

Conclusion

- **The successful synthesis ISB-PUs from different molecular weight of polyol.**
- **ISB-PUs from low molecular weight polyol doesn't exhibit high mechanical properties.**
- **The use of high molecular weight polyol is useful for low temperature properties.**

Acknowledgement

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