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The effect of isosorbide based multi-functional polyol in bio-based polyurethane for structural adhesives

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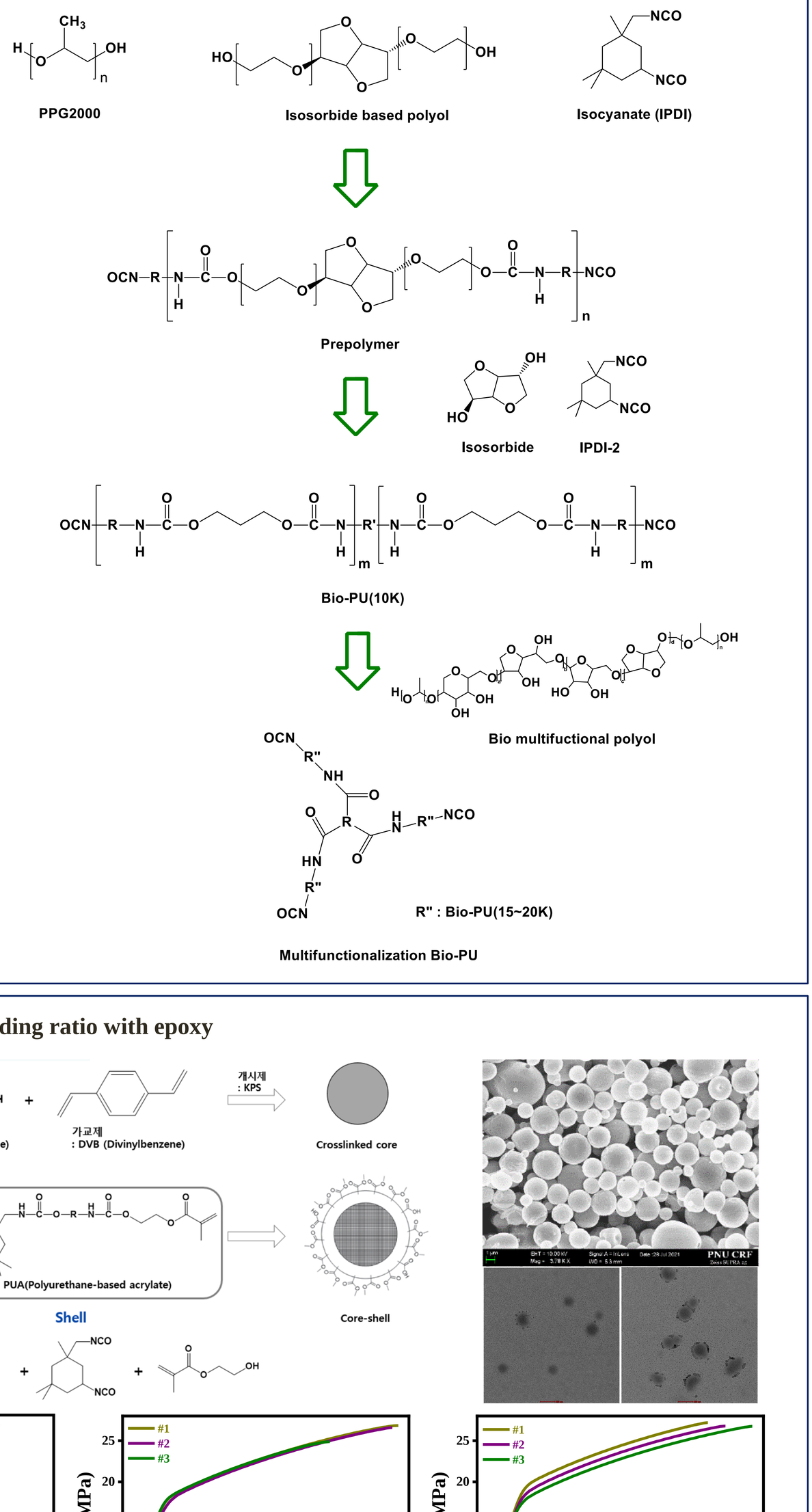
Abstract

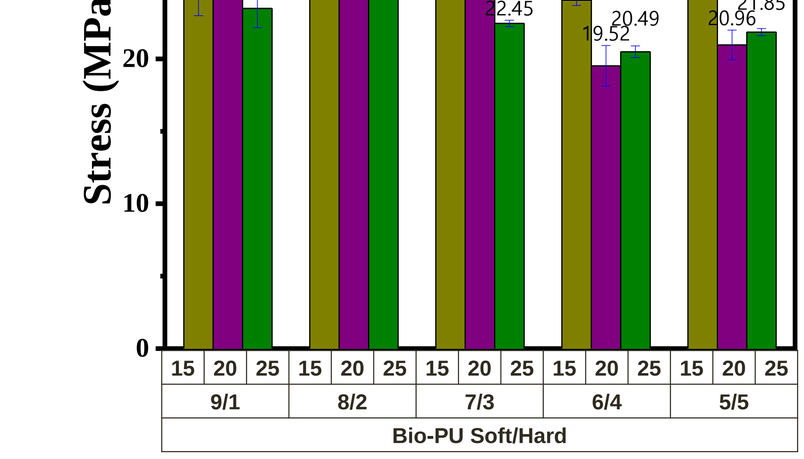
A series of bio-based polyurethanes (bio-PUs) was successfully synthesized by varying the hard/soft segment ratio from 9/1 to 5/5, isosorbide-based multi-functional polyol was used to improve the properties of structural adhesives. A series of bio-PUs was synthesized polyol as the soft segment and isosorbide (ISB) and isophorone diisocyanate (IPDI) as the hard segment, all with molecular weights of about 15,000 to 20,000 g/mol. Multi-functional polyol acted as an increase in molecular weight and significantly affected mechanical properties. The structure of the bio-PU series was analyzed by FT-IR (Fourier transform infrared spectroscopy) and GPC (gel permeation chromatography), and the shear strength was measured using UTM (Universal Testing Machine). In addition, hydroxyl-terminated polybutadiene (HTPB) was used for the core, which is to improve impact strength, and polyurethane acrylate (PUA) was used for the shell, successfully synthesized polyurethane-based core shell rubber (CSR).

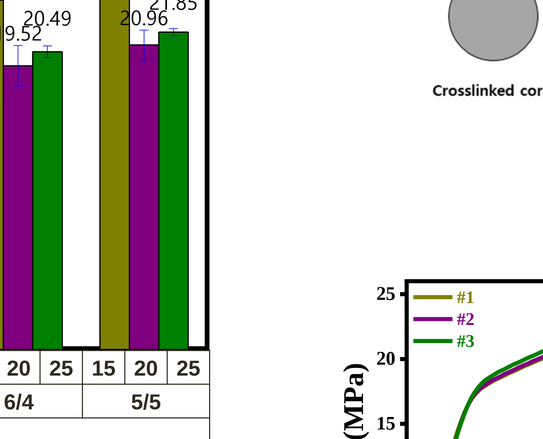
Experimental



Result & Discussion

1. **Reaction termination through confirmation of isocyanate (-NCO) peak**
2. **1.5 mol reaction of Bio-PU (10K) per 1 mol of multifunctional polyol**
   → **Target molecular weight (MW 15000)**





No.	Mn	PDI
9/1	16048	1.76
8/2	13802	1.43
7/3	17864	1.22
6/4	17931	1.89
5/5	14546	2.07

3. **The higher the hard segment ratio → the lower the shear strength and the lower the blending ratio with epoxy**
4. **Polymerization of two types of CSR (Core Shell Rubber) with PU**
   → **FE-SEM: Measuring the shape of a regular sphere of 3-6㎛**
5. **Shear strength → 5.12% and 8.42% increase, respectively**

Soft / Hard	15wt% #1	#2	#3	Avg.	20wt% #1	#2	#3	Avg.	25wt% #1	#2	#3	Avg.
9 / 1	27.18	27.50	26.34	24.89	26.94	25.50	24.88	26.71	22.77	21.19	26.13	23.48
8 / 2	29.93	27.12	Error	28.53	27.39	29.98	30.74	29.37	28.75	Error	26.35	27.55
7 / 3	27.41	26.12	26.78	25.86	26.43	27.15	27.45	26.82	22.52	22.08	22.72	22.45
6 / 4	23.91	24.90	24.46	24.06	18.03	18.21	24.2	19.52	20.36	19.95	21.79	20.49
5 / 5	25.94	26.84	25.09	25.81	22.02	20.42	19.68	20.96	21.91	21.99	22.02	21.85

Conclusion

- ✓ **Successful synthesis of bio-based polyurethanes and core shell rubber**
- ✓ **Soft/Hard ratio (9/1, 8/2, 7/3) → Maximum shear strength at 20wt%**
- ✓ **Securing a constant pore size of 3-6㎛ through spray drying of CSR**
- ✓ **Add an appropriate amount of two type CSR to epoxy → Maintain shear strength**

Acknowledgement

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