

Bio-polyurethane adhesive reinforced with core shell rubber for improvement of mechanical properties

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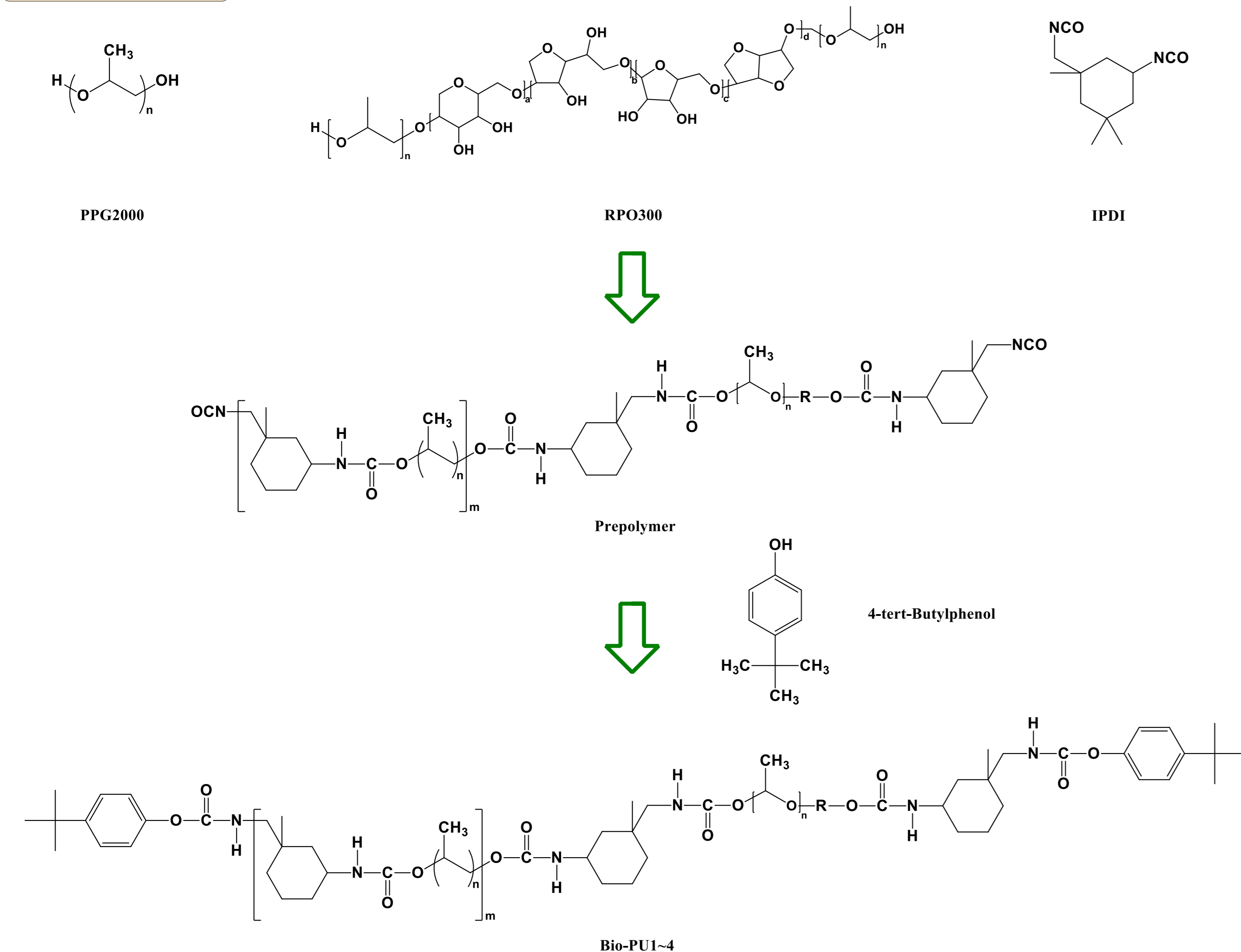
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Abstract

경질/연질 세그먼트 비율을 다양하게 변경하여 바이오 기반 폴리우레탄(Bio-PU) 시리즈를 성공적으로 합성하였다. 이소소르비드(ISB) 기반 다관능 폴리올을 연질 세그먼트로 사용하여 구조용 접착제의 특성을 개선하고, 이소소르비드와 이소포론 디이소시아네이트(IPDI)를 경질 세그먼트로 사용하였다. 생성된 생물-PU의 분자량은 15,000~20,000g/mol 범위를 보였다. 다관능 폴리올은 분자량 증가에 기여했으며 기계적 특성에 상당한 영향을 보였다. Bio-PU의 구조는 FT-IR(Fourier transform infrared spectroscopy)과 GPC(gel permeation chromatography)를 사용하여 분석했으며, 전단 강도는 UTM(Universal Testing Machine)을 사용하여 측정했다. 또한, 충격 강도를 향상시키기 위해 코어에 하이드록실 말단 폴리부타디엔(HTPB)을 사용하고 셸에 폴리우레탄 아크릴레이트(PUA)를 사용하여 폴리우레탄 기반 코어셸 러버(CSR)를 성공적으로 합성하였다.

Experimental & Result (Bio-PU)

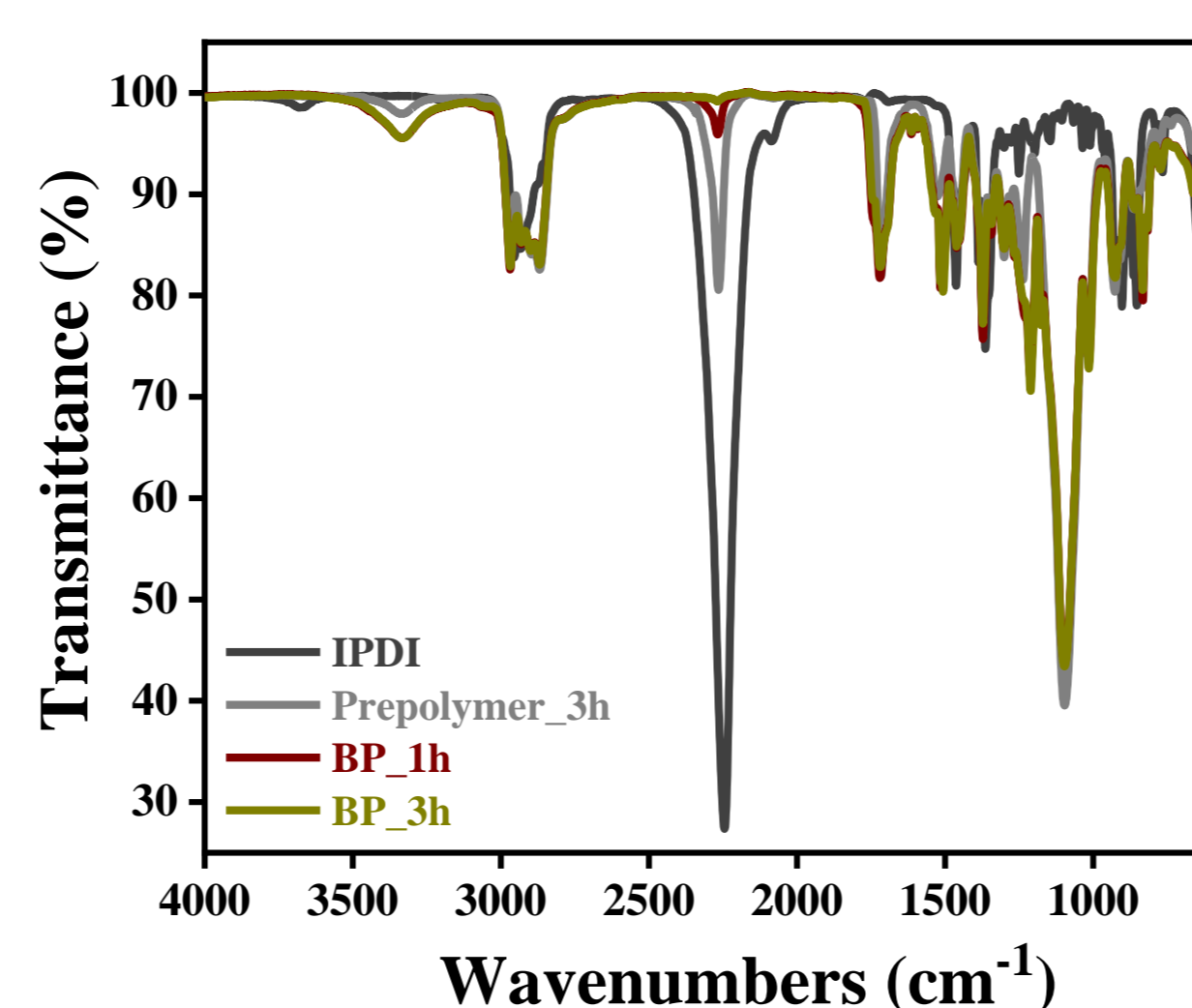
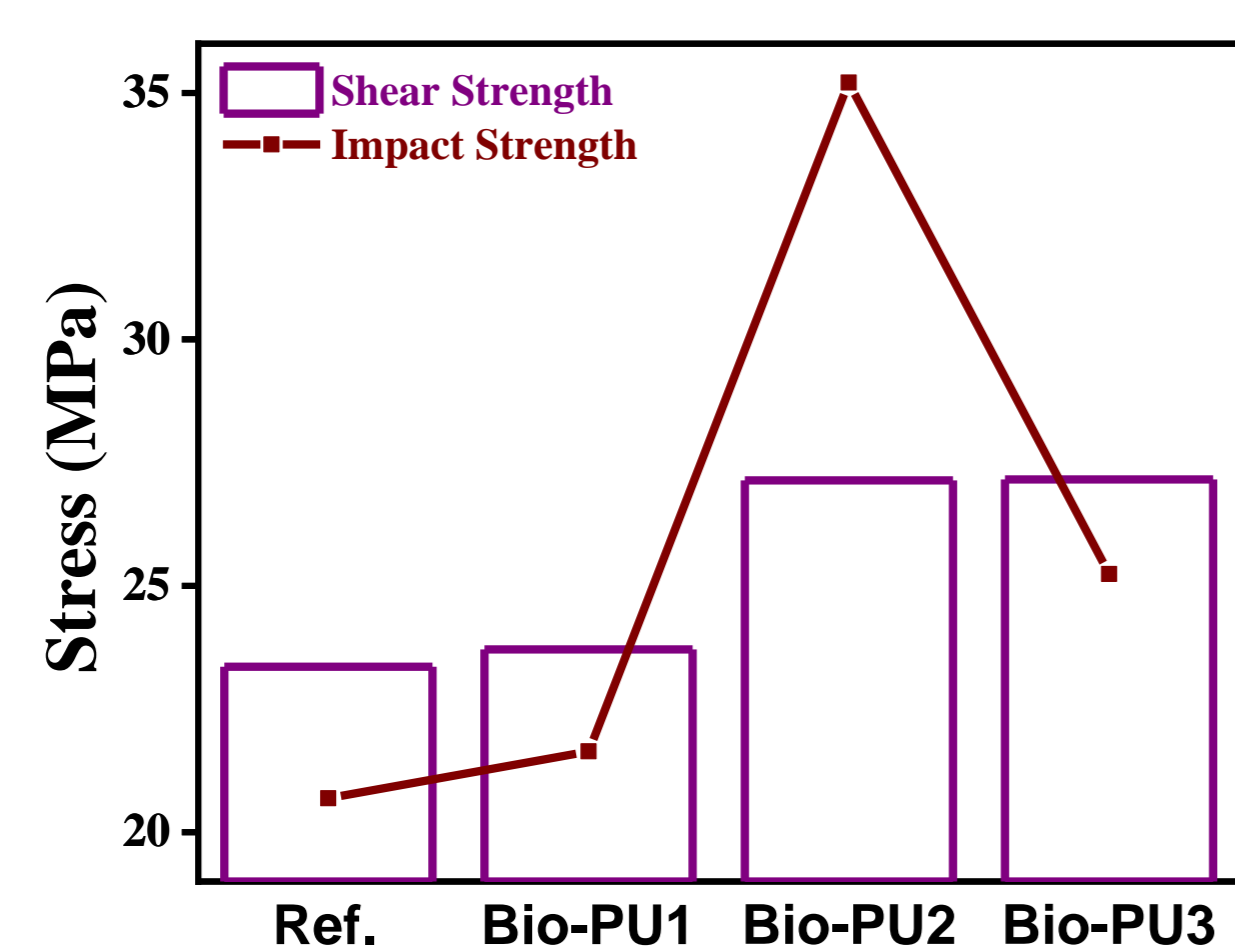
Scheme



Use of biomass material (RPO300) based on petroleum polyol (PPG2000) prepolymer

- Set BP capping to Ref. for prepolymer using PPG2000 and IPDI (optimal mixing ratio design)

→ Polymerization proceeds with a Total of three equivalent ratios of PPG2000 and RPO300



	Polyol		Isocyanate	GPC data			NCO% titration		Thermal properties		Mechanical properties	
	PPG2000 (eq)	RPO300 (eq)		Mn (g/mol)	Mw (g/mol)	PDI (Mw/Mn)	Theoretical value	Measurements	T _d	T _g	Shear Strength (MPa)	Impact Strength (MPa)
Ref.	1.0	0	7716	9706	1.26	3.44	3.68	138.5	-56.3	23.36	20.69	
Bio-PU1	0.9	0.1	7934	9985	1.26	3.77	3.77	143.4	-54.4	23.71	21.64	
Bio-PU2	0.7	0.3	7396	8984	1.21	4.26	4.31	153.9	-52.9	27.14	35.21	
Bio-PU3	0.5	0.5	8049	10090	1.25	5.06	5.19	144.1	-35.2	27.16	25.24	

Experimental & Result (CSR)

Scheme

CSR (Core Shell Rubber) Polymerization

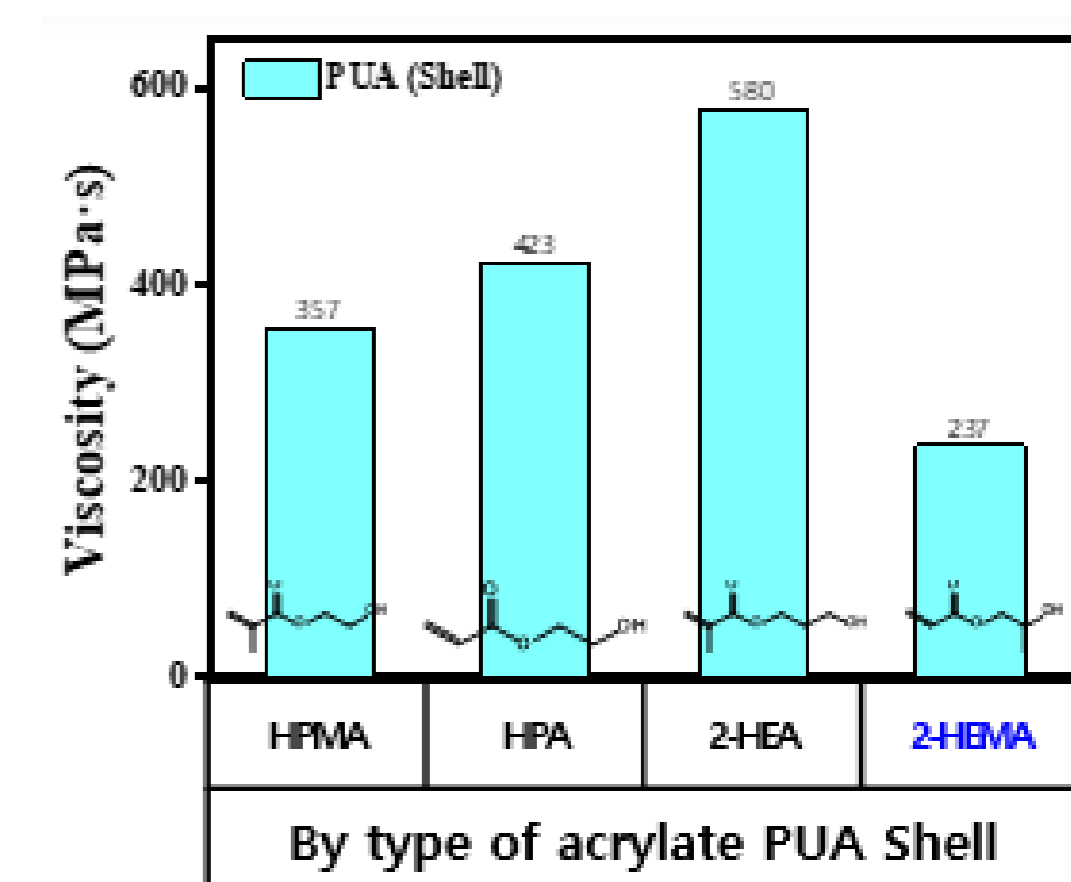
[Core] HTPB, surfactant (SDS), crosslinker (DVB), initiator (KPS) content Split
--> Derivation of optimal mixing ratio

[Shell] Using PUA (Polyurethane-based acrylate)

- Addition of MMA after polymerization of prepolymer to lower viscosity (for the purpose of adding shell and polymerization)

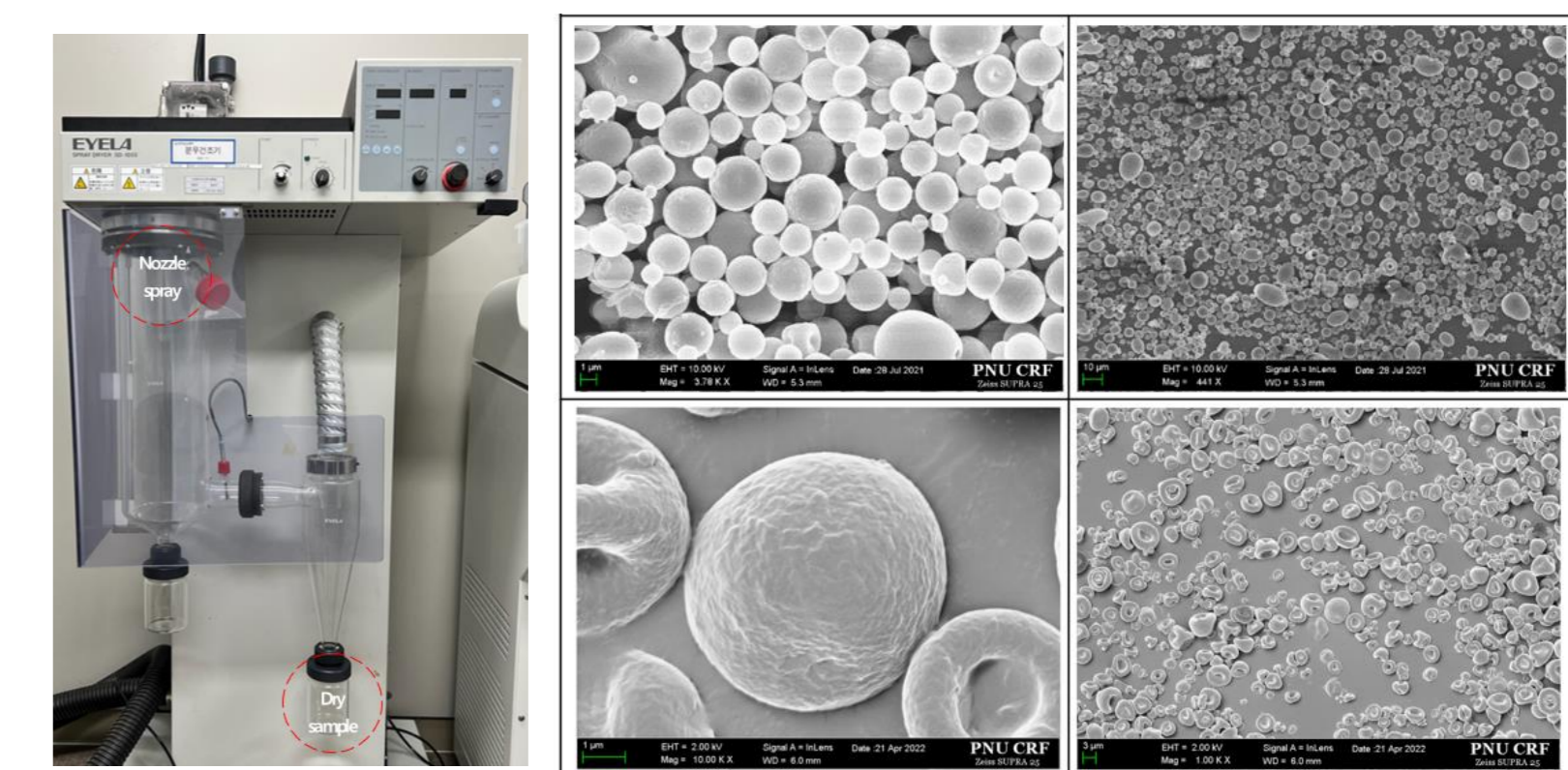
Viscosity (PUA)

Acrylate	Viscosity (25°C, mPa·s)
HPMA	357
HPA	423
2-HEA	580
2-HEMA	237



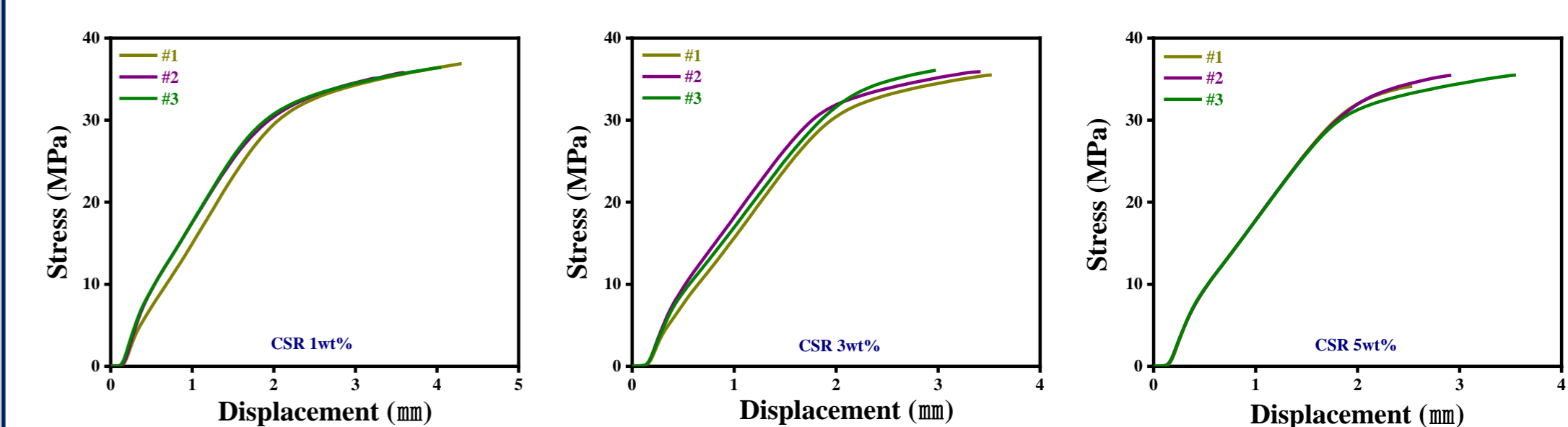
Surface analysis (FE-SEM/TEM)

Spray drying → Surface analysis result → uniform particle size of about 5 ~ 6μm



Mechanical properties

As the wt% of CSR increases, the shear strength decreases
→ But it is maintained as much as the existing EPOXY



Conclusion

- Successful synthesis of bio-based polyurethanes and core shell rubber
- Improving impact strength of bio-based polyurethane
- Securing a constant pore size of 3-6μm through spray drying of CSR
- Add an appropriate amount of CSR to epoxy → Maintain shear strength

Acknowledgement

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