Polyurethane's properties with various hard/soft alternates in same molecular weight

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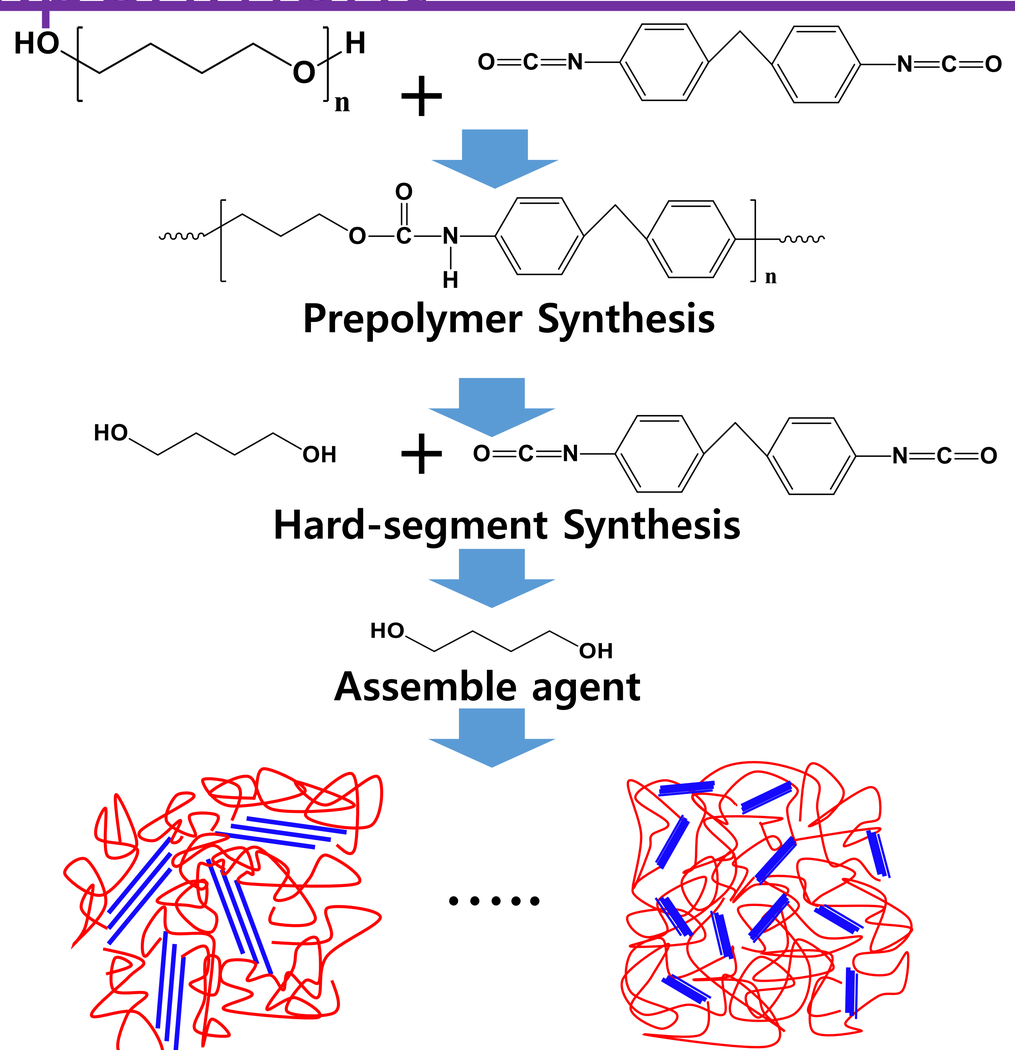
Abstract

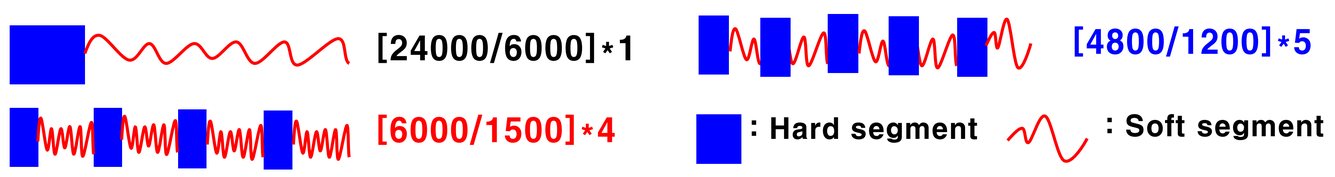
A series of thermoplastic polyurethane (TPU)s with architectures of different hard/soft block ratios were synthesized by solution polymerization based on 4,4′-methylenediphenyl diisocyanate (MDI), poly(tetrahydrofuran) (PTMG) (Mn ~ 1000), and 1,4-butanediol (1,4-BD). Shape-memory and stress-strain studies were carried out to elucidate the structure-property relationships existing in these TPUs. The hydrogen bonding of hard block and the flexibility of soft block exhibited a positive effect on the mechanical and shape-memory properties. Thermal and mechanical properties of TPUs were studied by differential scanning calorimetry (DSC), dynamic mechanical thermal analysis (DMTA), and tensile testing. Morphological properties of TPUs studied on the shape-memory will be discussed.

Experiment

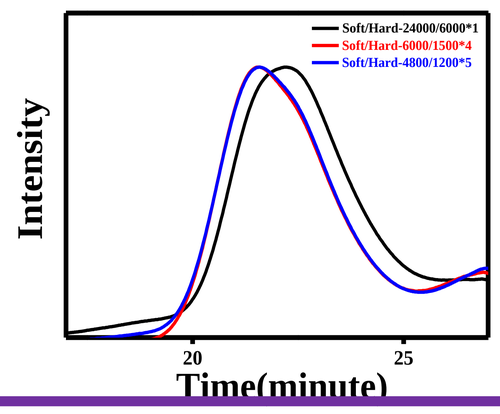


Hard/Soft segment ratio effect of PU synthesis with same molecular weight

Scheme

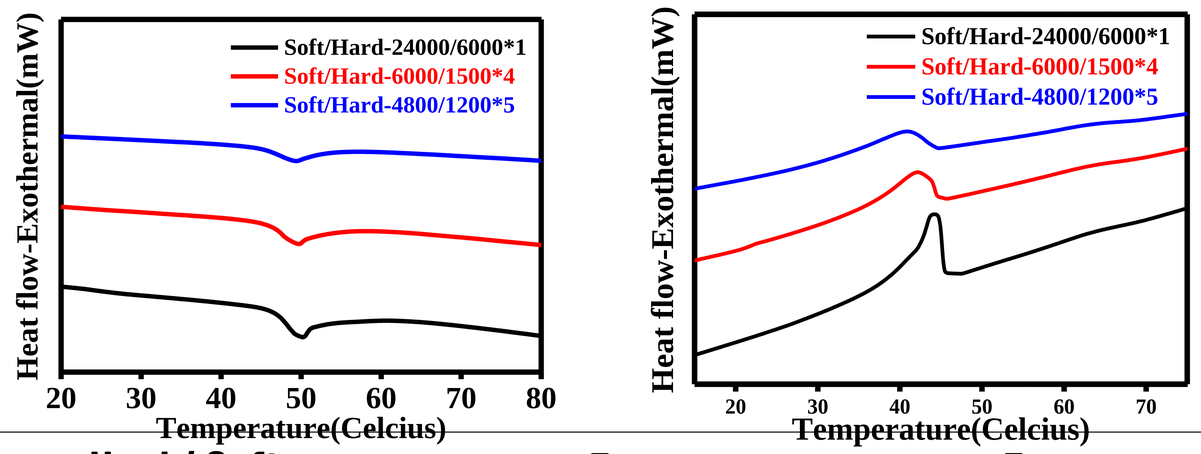


GPC



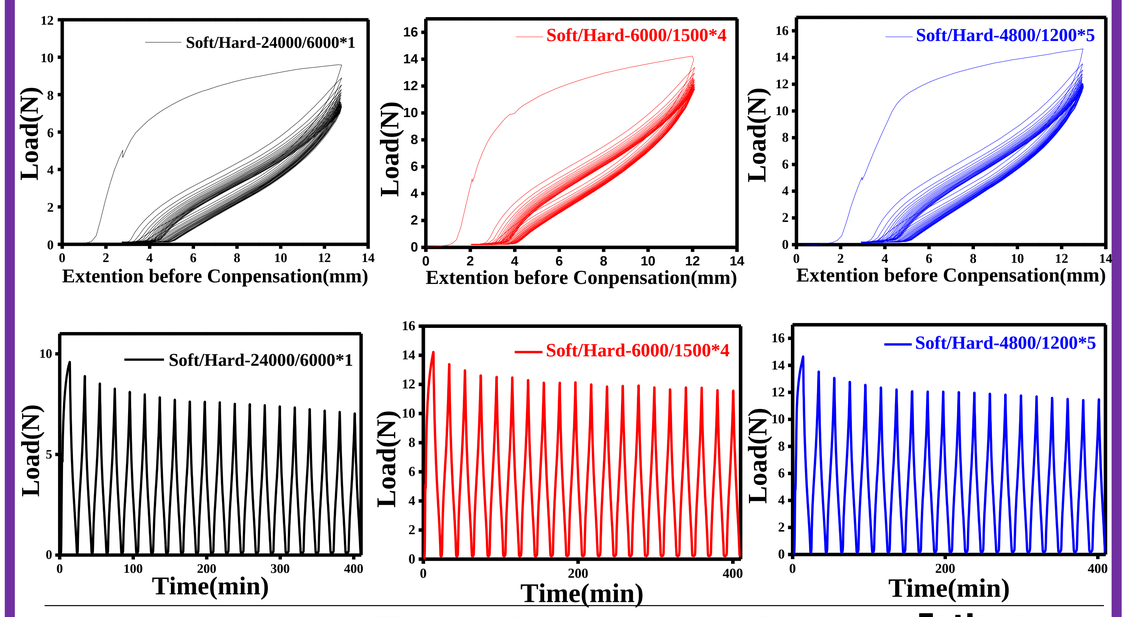
Hard / Soft	Molcular Weight(Mn)	PDI
[24000/6000]*1	32942	1.54
[6000/1500]*4	36686	1.52
[4800/1200]*5	35969	1.52

DSC-Soft segment



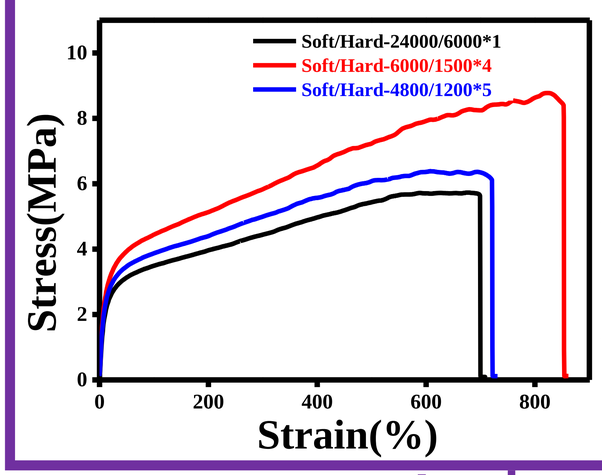
Hard / Soft	Tm	Tc
[24000/6000]*1	50.22	44.79
[6000/1500]*4	49.68	43.30
[4800/1200]*5	49.49	41.99

UTM-Hyteresis



Hard / Soft	First cycle load(N)	Las cycle load(N)	Fatigue Rate(%)
[24000/6000]*1	9.61	7.13	25.78
[6000/1500]*4	15.31	12.48	18.39
[4800/1200]*5	14.74	11.64	21.05

UTM-Pull to Break



Hard / Soft	Stress at Maximum Load(Mpa)	Youngs Modulus (Mpa)	Strain at break(%)
[24000/6000]*1	5.70	33.00	731
[6000/1500]*4	9.17	39.10	861
[4800/1200]*5	6.43	34.63	708

Conclusion

1. Various Hard/soft alternates lead to the change of mechanical and thermal properties on the same molecular weight
2. A hard/soft alternate type of [6000/1500]*4 has the highest mechanical property in this experiments.
3. Hard segment with well disperstion in molecular arrangement appeared different macroscopically effects.
4. Alternating of hard segment in molecular arrangement dispersion the interesting phenomenon.

Acknowledgment

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