PRESM 2022
Precision Engineering and Sustainable Manufacturing 2022 (PRESM2022)
July 20 - 22, 2022 | Jeju Booyoung Hotel & Resort, Korea

The effect of NCO content in polyurethane foam for automotive instrument panel

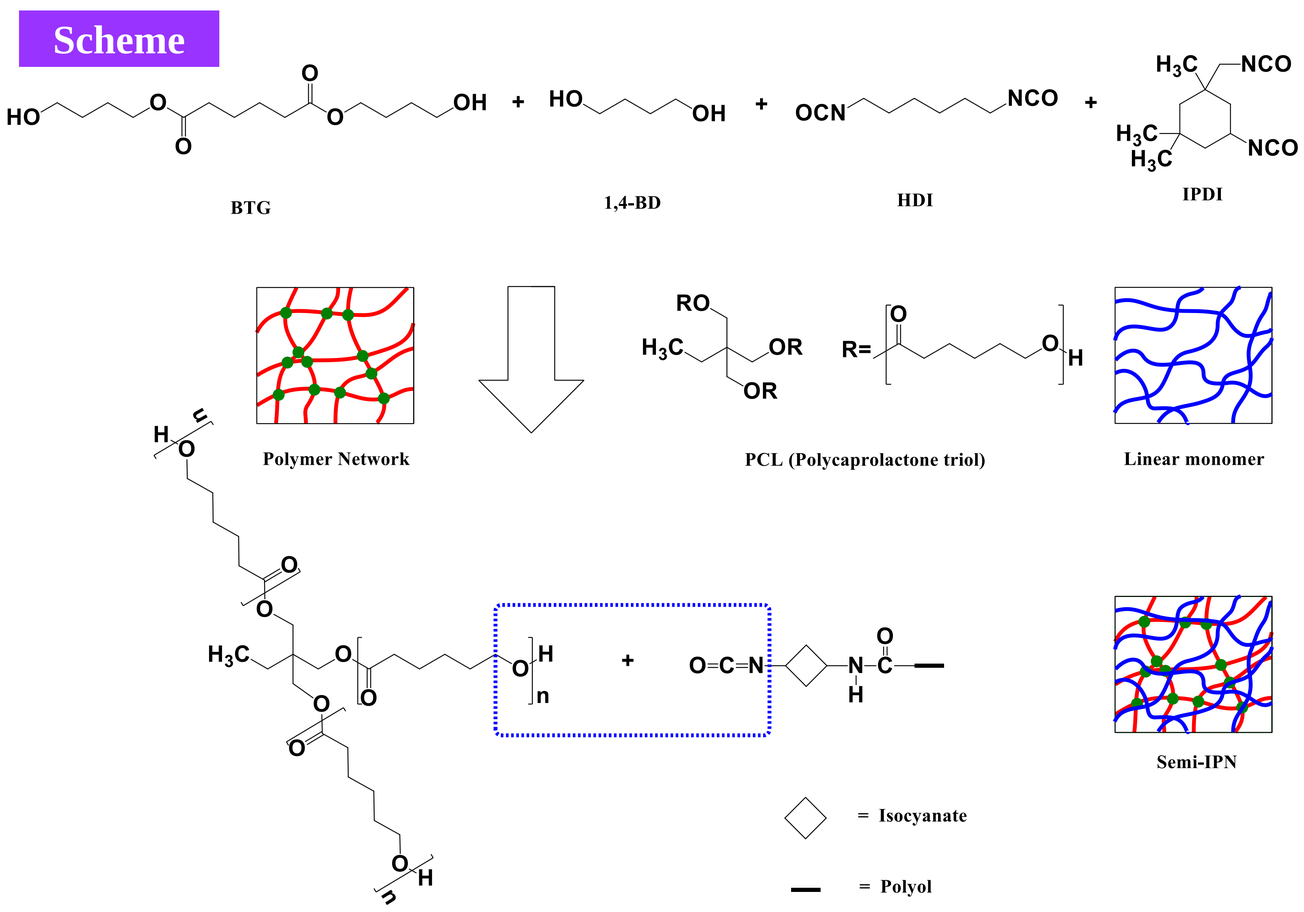
*Jin-Gyu Min, Ji-Hong Bae, Young-Hyun Mo, Won-Bin Lim, Ju-Hong Lee, Ji-Won Hwang, PilHo Huh**
Department of Polymer Science and Engineering, Pusan National University, Busan 46241, South Korea
** pilho.huh@pusan.ac.kr*

Abstract

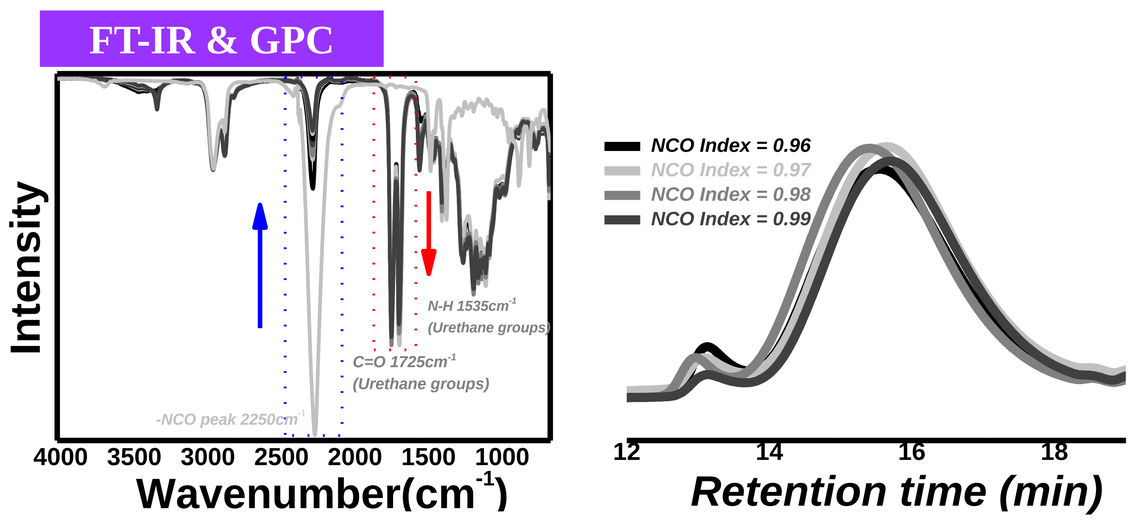
A thermoplastic polyurethane (TPU) series for automotive panels with high durability have been newly synthesized using the reacting process based on polyester polyol (BTG), polycaprolactone triol (PCL), hexamethylene diisocyanate (HDI), isophorone diisocyanate (IPDI), and 1,4-butanediol chain extender as a function of NCO/OH ratio (NCO index). The dependence of varying NCO index of synthesized TPUs on tensile strength and hardness have evaluated. To form PU foams with suitable rigidity and uniform skin-pores, the optimal synthetic process was controlled precisely by the amount of solvent, foaming agent, silicone surfactant, and catalysts content. A considerable NCO index dependence was observed in the range of 0.96 ≤ NCO index ≤ 0.99 at almost same molecular weight. When NCO index of TPU was 0.98, mechanical properties achieved maximum value due to the uniform open cell structure of molding PU foam. With the ratio of NCO/OH increasing, the hardness of PU foam also increased until 0.98 NCO index while the hardness of 0.99 NCO index decreased. The designed TPU with 0.98 NCO could be a promising formulation for molding foams of automotive skin panels and seating.

Experimental

Scheme



FT-IR & GPC



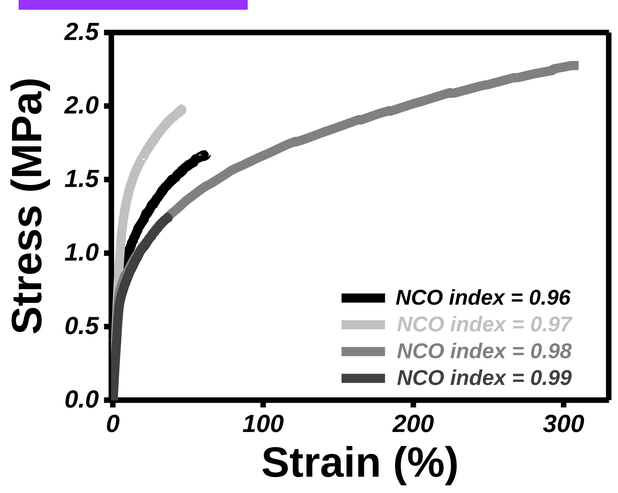
Sample Code	Reactants (g)			
	BTG	1,4-BD	HDI	IPDI
NCO index = 0.96	39.5795	2.9205	6.0949	2.6154
NCO index = 0.97	39.5795	2.9205	6.1493	2.6387
NCO index = 0.98	39.5795	2.9205	6.2234	2.6676
NCO index = 0.99	39.5795	2.9205	6.2840	2.6965

BTG/1,4-BD/PCL	HDI/IPDI	CAP1320	B8409	Tin catalyst	Amine catalyst
100	20.7	6.0	2.0	0.6	0.6

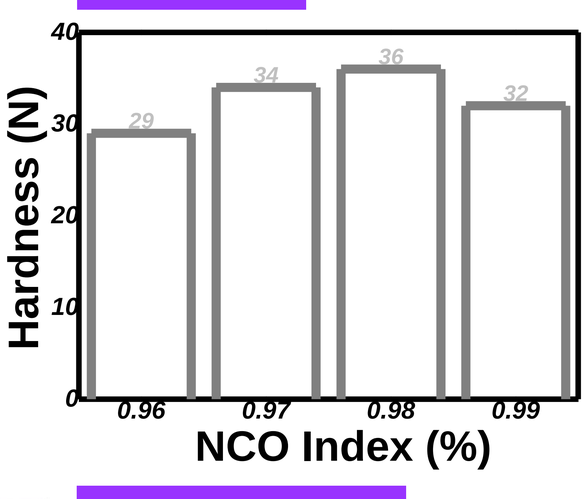
Unit pphp (pphp : part hundred polyol)

Results

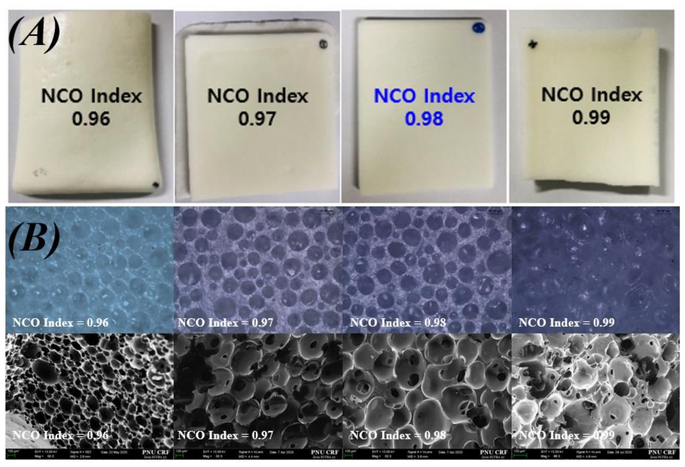
Film-UTM



Hardness



FE-SEM / Density



NCO%=0.98, cell porosity became much more homogeneous to about 200㎛.

(10cm × 10cm × 1cm)

NCO Index	Mass (g)	Density (g/㎤)
0.96	22.57	0.2257
0.97	22.24	0.2224
0.98	21.51	0.2151
0.99	23.12	0.2312

Conclusion

The cellular structure and mechanical properties of a PUF series have produced by compression molding have characterized with respect to NCO content, which leads to the structural change. As the NCO index increases, physical properties such as tensile strength, hardness, and pore uniformity have increased up to a limiting value of 0.98 and then have changed very dramatically. These information can be very useful in designing an automotive instrument panel that, by combining the high homogeneity of the cellular structures and the good mechanical properties of a PUF. The realistic applications may be those of not only skin panel in solar irradiation during the vehicle operating, but also refrigerated material of perishable foodstuffs.

Acknowledgement

This work was supported by a 2-Year Research Grant of Pusan National University.