

The effect of NCO content in thermoplastic polyurethane for automotive skin panels

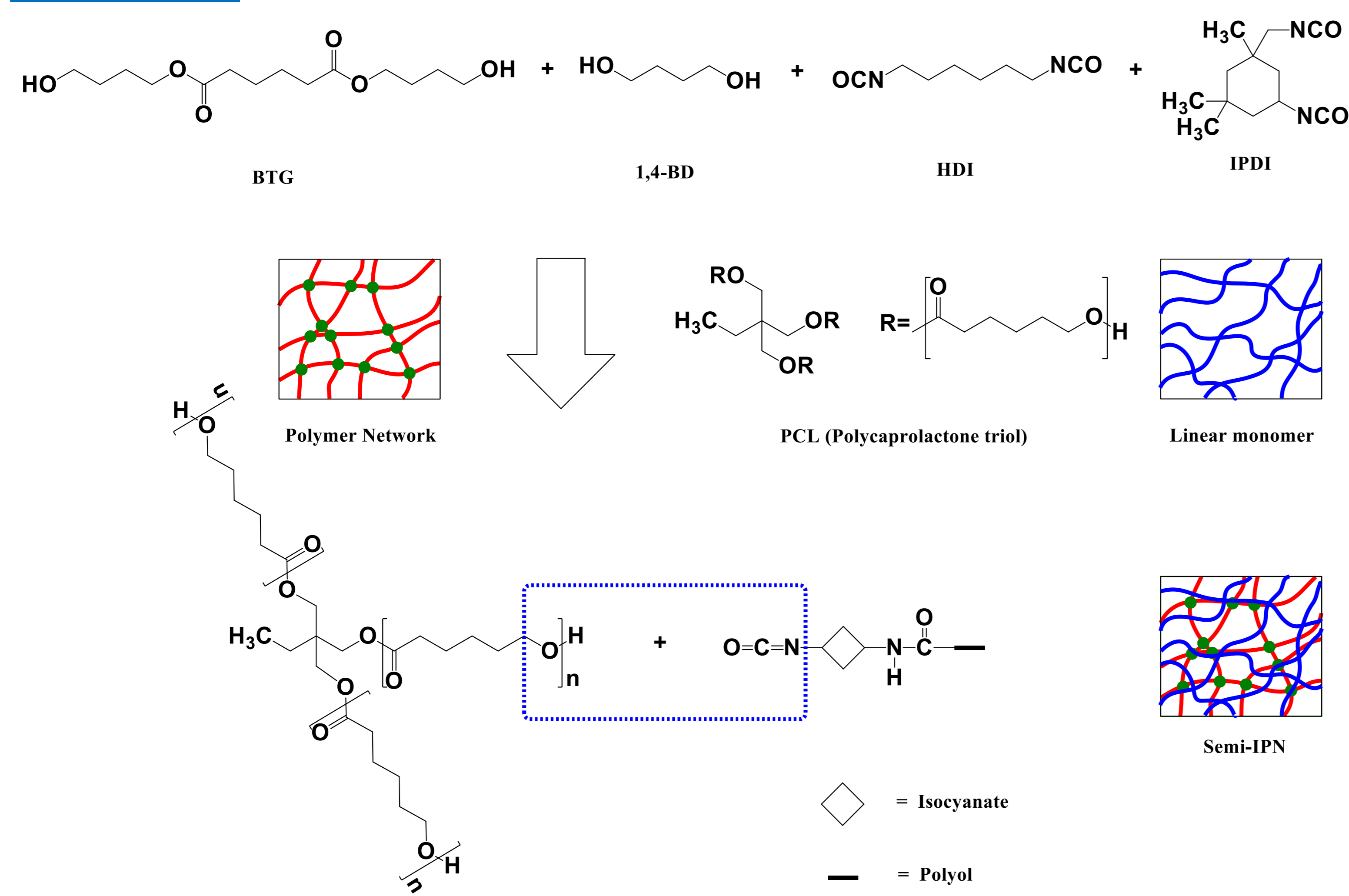
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Abstract

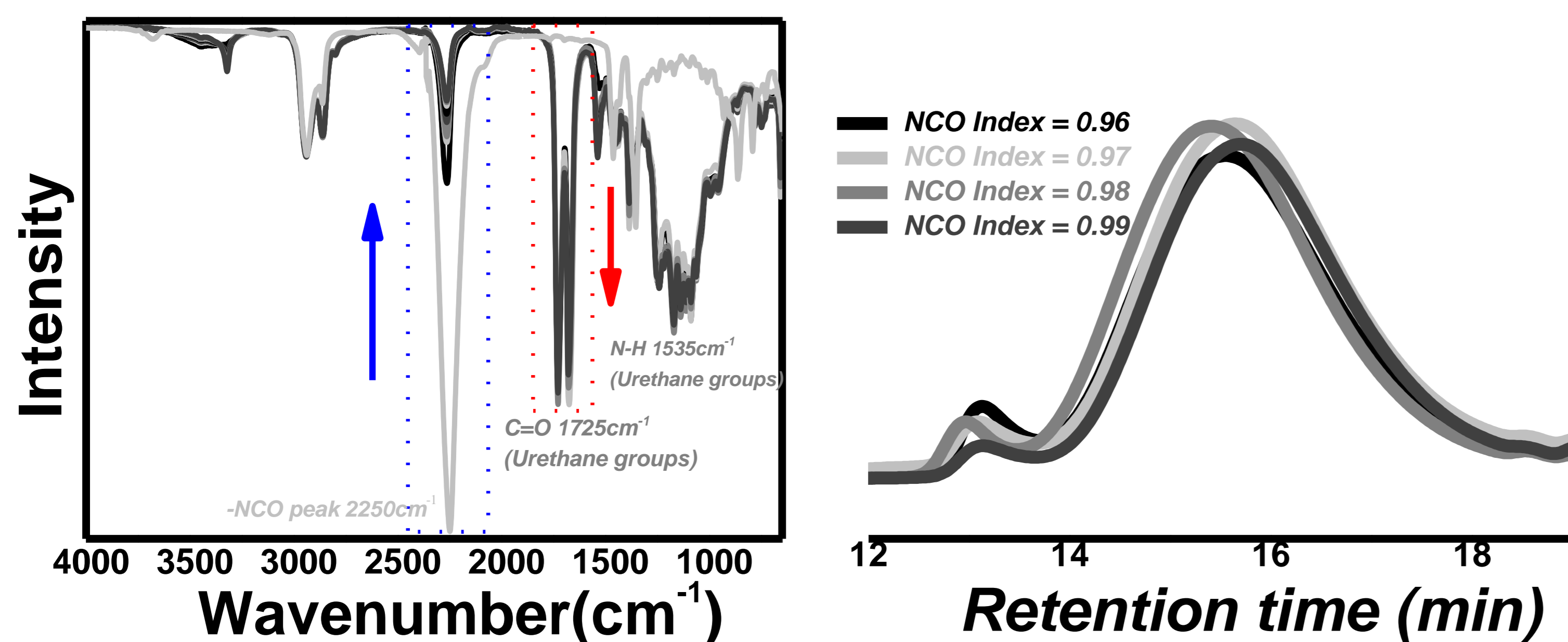
A thermoplastic polyurethane (TPU) series for automotive panels with high durability have been newly synthesized using the reacting process based on polyester polyol (BTG), polycaprolactone triol (PCL), hexamethylene diisocyanate (HDI), isophorone diisocyanate (IPDI), and 1,4-butanediol chain extender 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 $0.96 \leq \text{NCO index} \leq 0.99$ 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



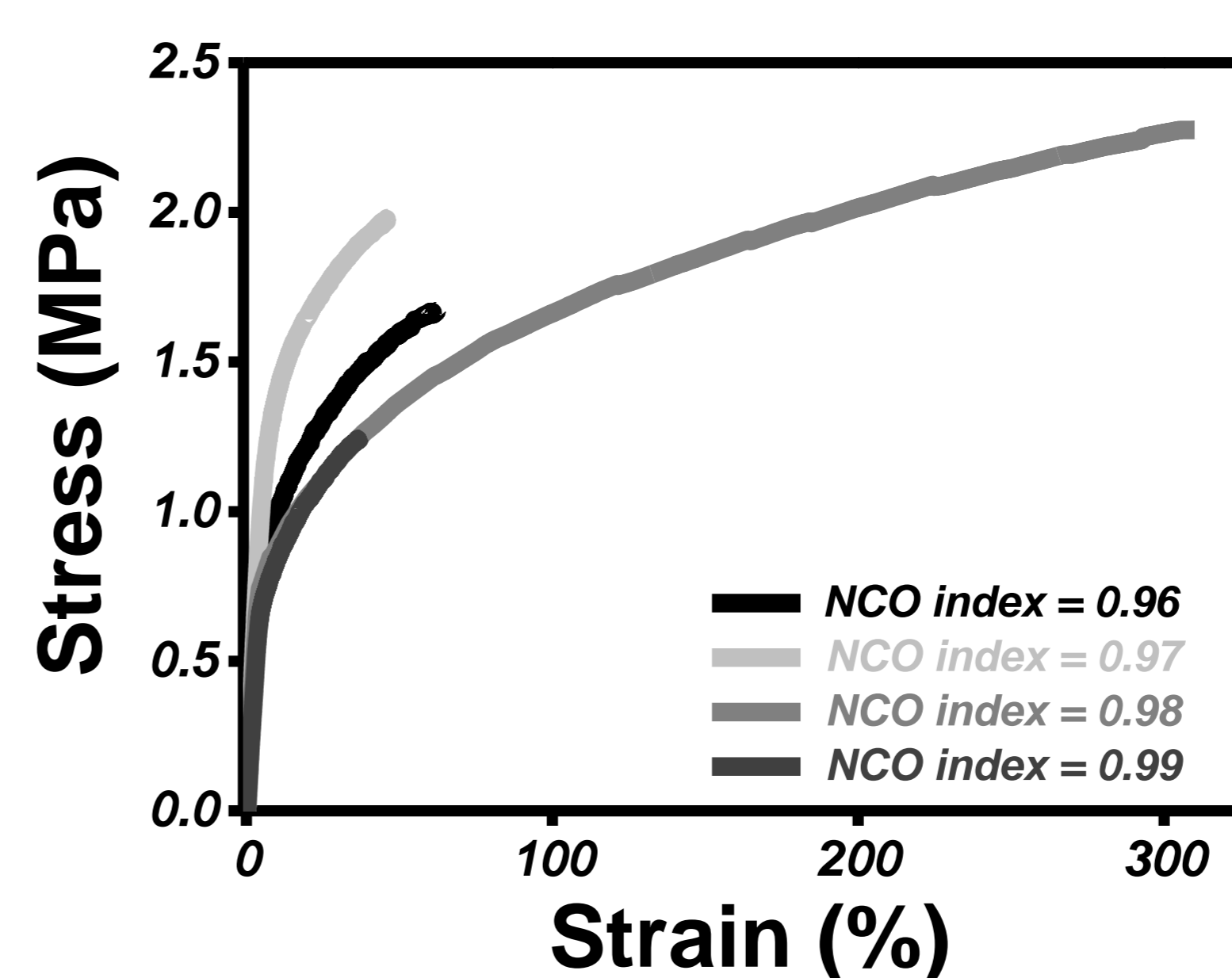
Results

GPC Table

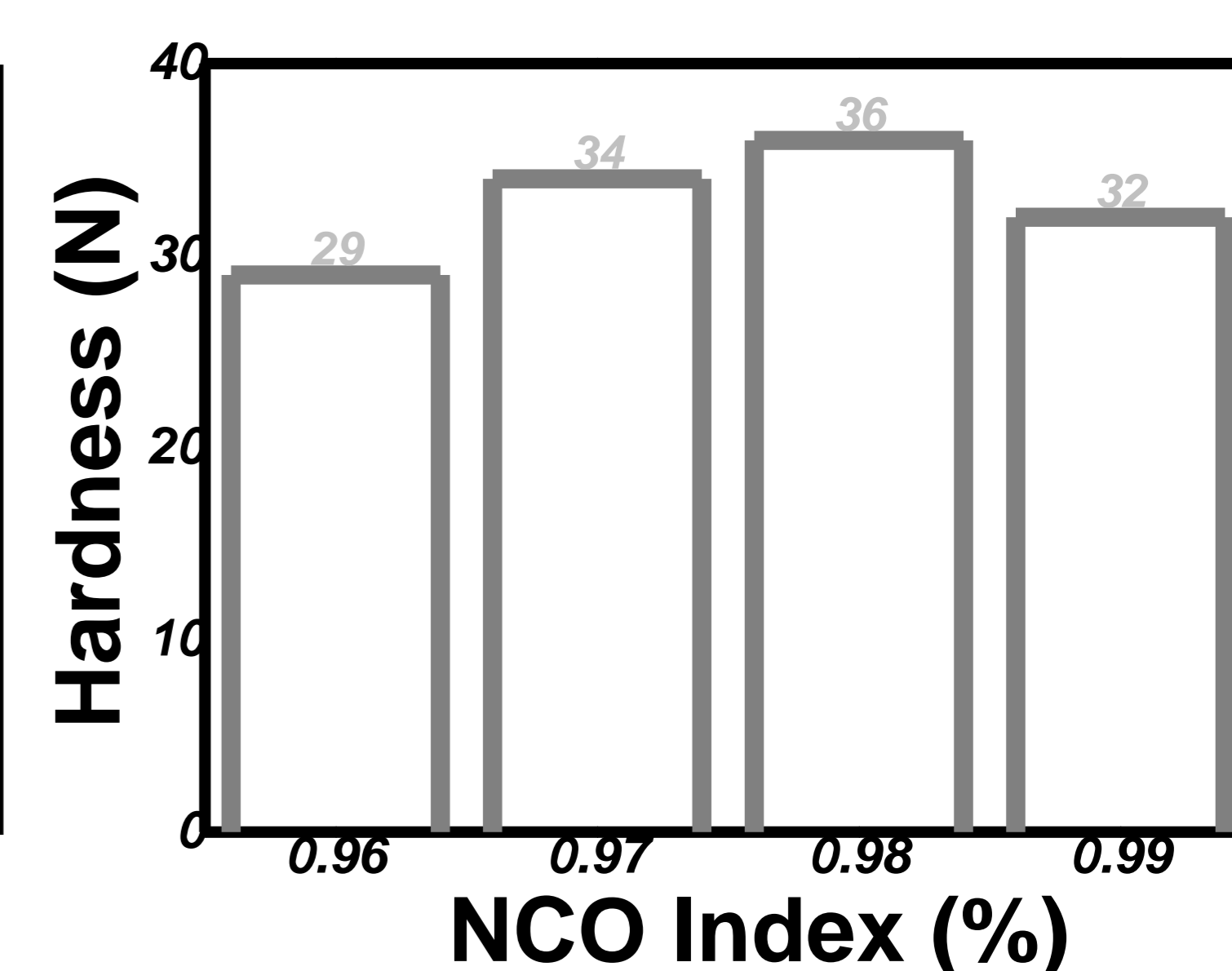
| Sample Code | Reactants (g) | | | |
|------------------|---------------|--------|--------|--------|
| | BTG | 1,4-BD | HDI | IPDI |
| NCO index = 0.96 | 39.5795 | 2.9205 | 6.0949 | 2.6154 |
| NCO index = 0.97 | 39.5795 | 2.9205 | 6.1493 | 2.6387 |
| NCO index = 0.98 | 39.5795 | 2.9205 | 6.2234 | 2.6676 |
| NCO index = 0.99 | 39.5795 | 2.9205 | 6.2840 | 2.6965 |
| BTG/1,4-BD/PCL | 100 | 20.7 | 6.0 | 2.0 |
| HDI/IPDI | | | 0.6 | 0.6 |
| Tin catalyst | | | 0.6 | 0.6 |
| Amine catalyst | | | 0.6 | 0.6 |

Unit pphp (pphp : part hundred polyol)

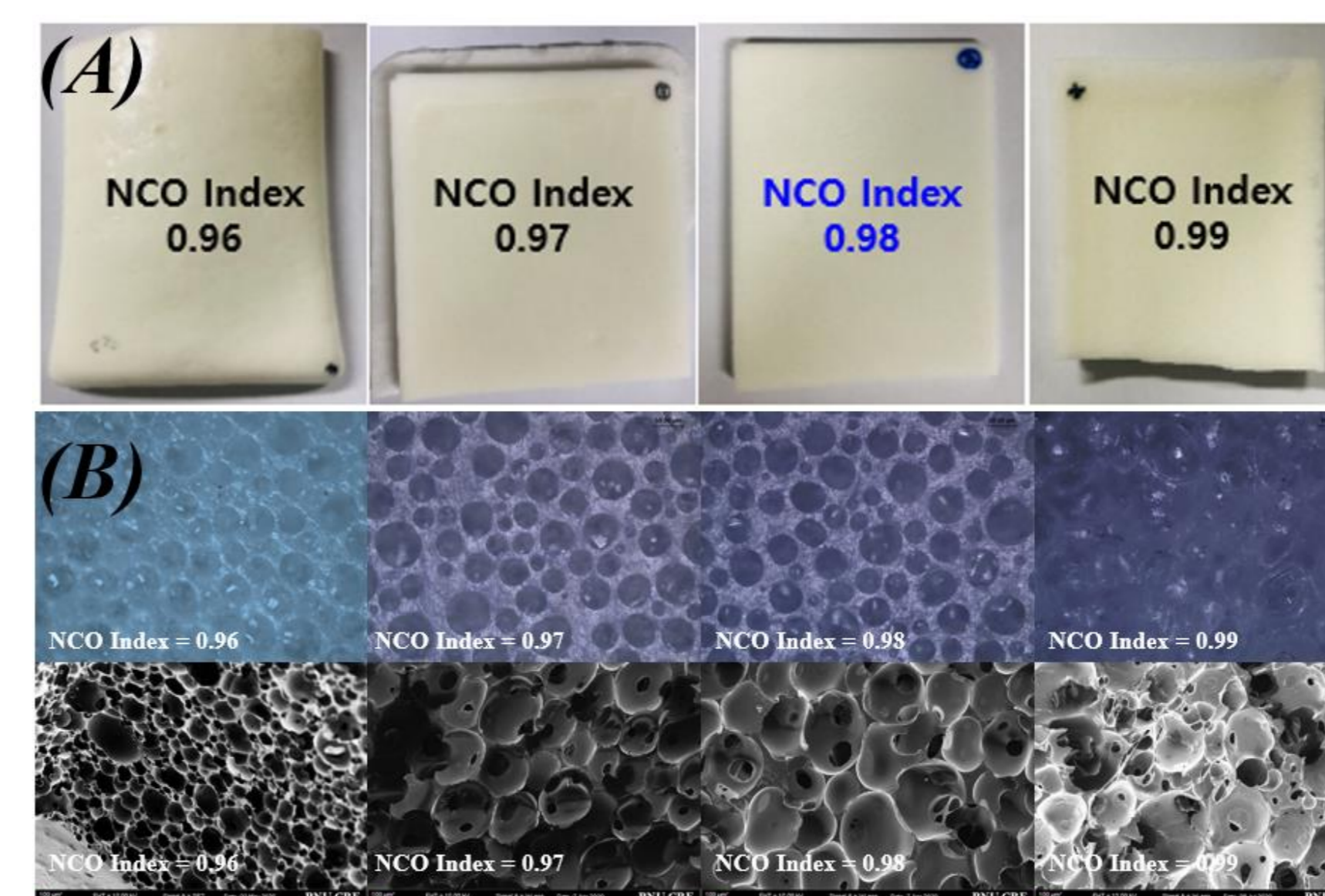
Film-UTM



Hardness



FE-SEM / Density



NCO%=0.98, cell porosity became much more homogeneous to about $200\mu\text{m}$.
(10cm × 10cm × 1cm)

| NCO Index | Mass (g) | Density (g/cm ³) |
|-----------|----------|------------------------------|
| 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 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.

Acknowledgement

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