Comparison of mechanical properties of porous polyurethane gels with different molecular structures.

Ryosuke Iwayama[1], Kazuki Nakanishi[1,2] and George Hasegawa[1,2]
[1] Department of Applied Materials Chemistry, Nagoya University
[2]Institute of Materials and Systems for Sustainability, Nagoya University
iwayama.ryosuke.n0@s.mail.nagoya-u.ac.jp

Introduction

Porous monolithic materials generally have low thermal conductivity and are expected to be useful as thermal insulators. However, their practical application is difficult due to their low mechanical strength. Therefore, it is important to construct a mechanically strong pore structure composed of tough and flexible polymer network. For example, it has recently been reported that porous phenolic resins with a three-dimensionally linked structure of rod-like gel skeletons with branching exhibit high elastic modulus and yield stress and excellent flexibility.

In this study, a sol-gel method with phase separation [1] was used to prepare porous polyurethane gels from different precursors. The pore structure of porous PU gels was controlled by inducing spinodal decomposition by adding phase separation inducers to various PU polymerization reaction systems and freezing the transient structures by sol-gel transition. In addition, we investigated their mechanical properties to elucidate the effects of molecular structures on the mechanical strength of polyurethane gels.

Experimental Procedures

Polyurethane gels were prepared by reacting various combinations of diisocyanates and triols in organic solvents at 60 ºC. Linear polymers were introduced into this sol-gel reaction system to induce phase separation and control the pore structure. The resulting wet gel was washed with hexane and dried at atmospheric pressure to obtain porous polyurethane gels. The pore structure was observed by Scanning Electron Microscopy (SEM), Thermogravimetry-Differential Thermal Analysis (TG-DTA), and their mechanical properties were evaluated by mechanical tests.

Results and Discussion

By optimizing the type of phase separation inducers and the initial composition and synthesis conditions, we successfully synthesized porous polyurethane gels with a co-continuous structure using aliphatic or aromatic isocyanates as raw materials. As shown in Fig. 1, increasing the amount of phase separation inducers tended to coarsen the co-continuous structure. This presentation compares the uniaxial compression properties of porous polyurethane gels with different molecular structures and discusses the influence of the polymer network on mechanical properties.

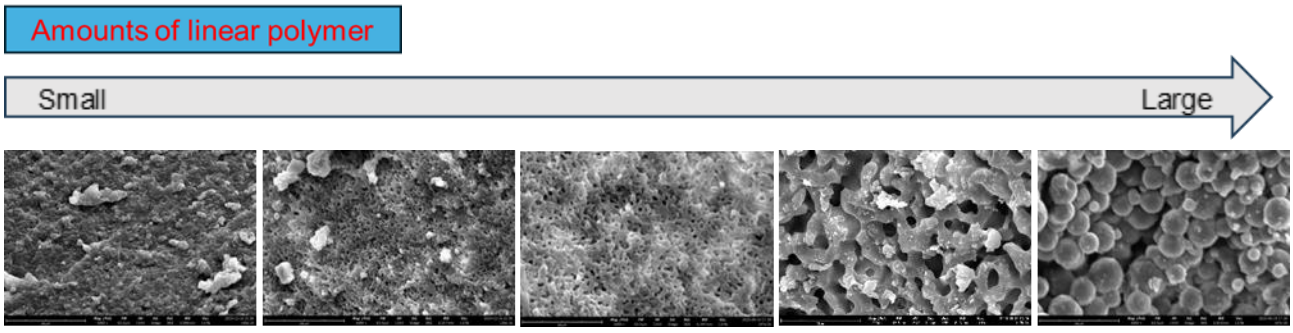

Fig. 1 Morphological change of the porous polyurethane monoliths prepared with varied amounts of phase separation inducer.

References

[1] K. Nakanishi, *J. Porous Mater. 1997*, **4**, 67.