Design and evaluation of mechanical properties of dissimilar polymer knitting materials with movable cross-links

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[Introduction] A design of cross-links affects mechanical properties of polymeric materials. Previously, the movable cross-links were formed during the bulk polymerization between cyclodextrin (CD) monomer and main chain monomer[1]. Herein, we designed the materials where movable cross-links connect between dissimilar polymers, and evaluated their mechanical properties.

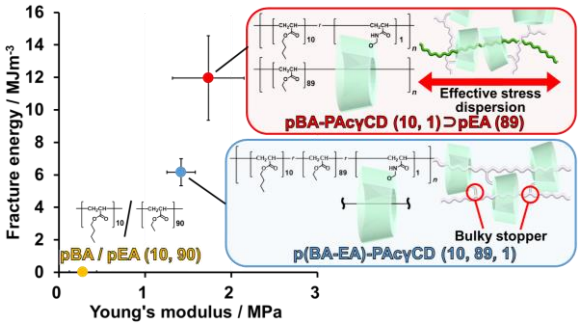

Figure 1. Prots of fracture energy *vs* Young's modulus for pBA-PAcγCD (10, 1)⊃pEA (89), p(BA-EA)-PAcγCD (10, 89, 1), and pBA / pEA (10, 90).

[Result] The dissimilar polymer knitting materials with movable cross-links (pBA-PAcγCD (*x*, *y*)⊃pEA (*z*)) were obtained by bulk polymerization of ethyl acrylate (EA) in the presence of the peracetylated-γCD modified poly(butyl acrylate) (pBA-PAcγCD). For evaluation of mechanical properties, tensile tests were carried out (Fig. 1). The polymer blend materials without cross-linking (pEA / pBA (10, 90): comparison) exhibited low fracture energy and plastic deformation. On the other hand, pBA-PAcγCD (10, 1)⊃pEA (89) showed higher fracture energy and clear fracture point. These results indicated that CD unit acts as cross-linking point to improve the fracture energy. In addition, the fracture energy of pBA-PAcγCD (10, 1)⊃pEA (89) is 1.9 times larger than that of the copolymer of EA and BA with movable cross-links (p(BA-EA)-PAcγCD (10, 89, 1): comparison). To evaluate stress dispersion property, we observed stress relaxation of test pieces stretched at 400%. As a result, the stress of pBA-PAcγCD (10, 1)⊃pEA (89) decreased faster than that of p(BA-EA)-PAcγCD (10, 89, 1). The sliding of CD units in p(BA-EA)-PAcγCD (10, 89, 1) were limited by another CD units as bulk stopper. pBA- PAcγCD (10, 1)⊃pEA (89) have more space over which CD unit can slide, leading effective stress dispersion to realize higher fracture energy.

1) R. Ikura, J. Park, M. Osaki, H Yamaguchi, A. Harada, Y. Takashima, *Macromolecules* **2019**, *52*, 6953-6962