

Dynamic Control of Slide-Ring Materials

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【Outline of survey】

Since the discovery of cross-linking in natural rubber with sulfur in 1839 by Goodyear, the cross-linking of polymeric materials has been one of the most important research subjects in polymer science and technology. We have recently developed a novel kind of cross-linked polymeric materials called *slide-ring materials* using *polyrotaxane*, the supramolecular architecture with topological characteristics. The slide-ring materials have figure-of-eight cross-linking junctions that can move freely in a polymer network. As a result, they show mechanical properties quite different from conventional cross-linked polymeric materials with fixed junctions.

In this project, we synthesize various polyrotaxanes of different axis polymer chains to create new slide-ring materials with controllable movements of cyclic molecules in polyrotaxanes. Then we aim to explore new properties and functions of the slide-ring materials and reveal the molecular mechanism by investigating the correlation between the nanoscopic sliding mode and macroscopic mechanical dynamics. This project will lead to the establishment of new field in polymer science on the basis of the novel concept of the freely movable cross-linking junction in a polymer network.

【Expected results】

By proposing a new theoretical model describing the slide-ring materials and finding new properties and functions based on the sliding mode, the project will yield a new area and bring large progress in polymer science. In addition, it will urge innovation to polymeric materials such as textiles, paints, films, adhesion, coating, biomaterials and so on since we will develop novel slide-ring materials with controllable dynamic properties in this project that have been not observed in conventional materials.

【References by the principal investigator】

- Y. Okumura and K. Ito; “The polyrotaxane gel: a topological gel by figure-of-eight cross-links”, *Advanced Materials*, **13**, 485-487(2001).
- J. Araki and K. Ito, “Recent advances in the preparation of cyclodextrin-based polyrotaxanes and their applications to soft materials”, *Soft Matter*, **3**, 1456-1473(2007).

【Term of project】 FY2008—2012

【Budget allocation】

155,900,000 yen (direct cost)

【Homepage address】

<http://www.molle.k.u-tokyo.ac.jp/>