Slide-Ring Network: Topological Supramolecular Architecture

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We have recently developed a novel type of gel called the *slide-ring gel or topological gel* that is different from physical and chemical gels by using polyrotaxane, the supramolecular architecture with topological characteristics. In this gel, polymer chains with bulky end groups exhibit neither covalently cross-links as in chemical gels nor attractive interactions as in physical gels but are topologically interlocked by figure-of-eight cross-links. Hence, these cross-links can pass along the polymer chains freely to equalize the tension of the threading polymer chains similarly to pulleys; this is called the *pulley effect*. The slide-ring gel is a new cross-linking concept for the polymer network as well as a real example of a slip-link model or sliding gel, which was previously considered only theoretically.

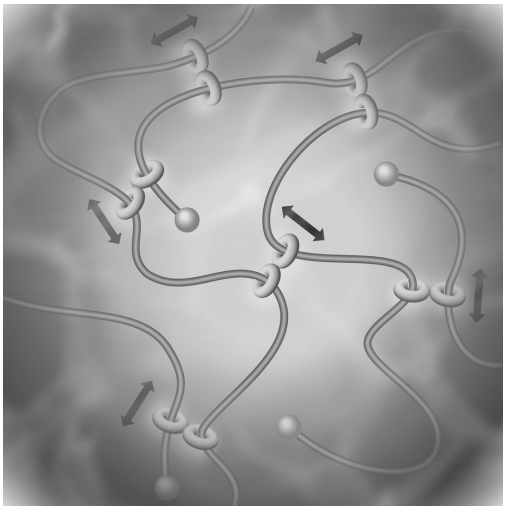

Fig.1. Schematic diagram of slide-ring gels using supramolecular network.

Because the cross-linking junction can move in the polymer network, the structure and physical properties of the polymeric materials are drastically different from conventional cross-linked or noncross-linked materials. It was observed from the SANS and SAXS studies that the slide-ring gels exhibited the normal butterfly pattern on uniaxial deformation different from the chemical gels with fixed junctions. And the mechanical properties of the slide-ring gel are quite different from those of conventional physical and chemical gels.

The concept of the slide-ring gel has recently yielded various new kinds of gels and fibers. It is not limited with cross-linked gels but also includes cross-linked polymeric materials without solvent. Accordingly it can be applied to wide area such as soft contact lens, inter ocular lens, cosmetic, textiles, paints, rubbers, household goods, farming materials, polymer battery, fuel cell, soft actuator and so on. This is important not only for the development of high-performance gels but also as a new framework for general polymeric materials.

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