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1. Main Research Results

1) Creation of new devices and materials was achieved in the developments of novel method of recycle use of crosslinked polymer and novel polymers directed toward utilization of sulfur as follows:

(1) Development of reversible crosslink-decrosslink system by external stimuli

By applying the reversible bonding-cleavage system of mechanical bond to polymer system which is developed in the synthesis of rotaxane using the reversible photocleavage of aromatic disulfide bond, novel functional molecules and materials responding toward external stimuli were created.

(2) Development of novel polymers for optical use

Design and synthesis of high performance polymers having spirobifluorene moiety with rectangular p electronic system were studied and novel optical use-oriented polymers with thermal stability as well as high refractive index and low birefringence were created.

(3) Development of new type of polymer: graft polyrotaxane

Graft polyrotaxanes as novel graft polymers of which graft chains have high freedom in their mobility and can change their length and density, were prepared and the unique properties of them were clarified.

In addition to the above three materials, fundamental studies on basic motion of linear molecular motors, stable artificial helical molecules with dynamic property, and novel concept for steric protection: dynamic steric protection, in addition to strong biological activity as anti-cancer agent of rotaxane.

2. List of publication (original article, comment/book)

1) Original Paper

- (1) Crown Ether-*tert*-Ammonium Salt Complex Fixed as Rotaxane and Its Derivation to Neutral Rotaxane; Kazuko Nakazono, Shigeki Kuwata, Toshikazu Takata, *Tetrahedron Lett.*, **49**, 2397 ~ 2401 (2008)
- (2) Fluorene-rich High Performance Polyesters: Synthesis and Characterization of 9,9-Fluorenylidene- and 2,7-Fluorenylene-based Polyesters with High Refractive Index and Low Birefringence, Surasak Seesukphronrarak, Shin-ichi Kawasaki, Toshikazu Takata, *J. Polym. Sci., Part A: Polym. Chem.*, **46**, 2549 ~ 2556 (2008)
- (3) Synthesis of Main Chain-Type Polyrotaxane by Polymerization of Homoditopic [2]Rotaxane Through Mizoroki-Heck Coupling, Takashi Sato, Toshikazu Takata, *Macromolecules*, **41**[7], 2739 ~ 2742 (2008)
- (4) A Novel Synthetic Route to Poly(crown ether) through Rotaxanation-Protection Protocol, T. Bilig, Y. Koyama, T. Takata, *Chem. Lett.*, **37**[4], 468 ~ 469 (2008)
- (5) Synthesis and Properties of Fluorine-Containing Poly(arylenemethylene) as a New Heat-Resistant

- Denatured Phenolic Resin, Tadamasu Nemoto, Gen-chi Konishi, Takayuki Arai, Toshikazu Takata, *Polym. J.*, **40** [7], 622 ~ 628 (2008)
- (6) Poly(vinylspirobifluorene): Synthesis and Property of A Novel Styrenic Polymer, Fumitaka Ishiwari, Shinichi Kawasaki, Yasuhito Koyama, and Toshikazu Takata, *Chem. Lett.*, **38**[8], 853 ~ 854 (2008)
 - (7) New Click Chemistry: Click Polymerization via 1,3-Dipolar Addition of Homo Ditopic Aromatic Nitrile Oxides, Yasuhito Koyama, Morio Yonekawa, and Toshikazu Takata, *Chem. Lett.*, **37**[9], 918 ~ 919 (2008)
 - (8) Fine Dispersion of Carbon Black in Fluorene-Based Resin, Shin-ichi Kawasaki, Masahiro Yamada, Kana Kobori, Fengzhe Jin, Toshikazu Takata, *Polymer Composites*, **29**[9], 1044 ~ 1048 (2008)
 - (9) Synthesis, Structure, and Properties of Polyacetylenes Possessing Chiral Spirobifluorene Moieties in the Side Chain, Toshikazu Takata, Fumitaka Ishiwari, Takashi Sato, Ryota Seto, and Yasuhito Koyama, *Polym. J.*, **40**[9], 846 ~ 853 (2008)
 - (10) Thermodynamically and Kinetically Unfavored Transposition of Wheel Component in Rotaxane, Yoshimasa Makita, Nobuhiro Kihara, Toshikazu Takata, *J. Org. Chem.*, **73**[23], 9245 ~ 9250 (2008)
 - (11) Polyrotaxane Networks Formed via Rotaxanation Utilizing Dynamic Covalent Chemistry of Disulfide, Tuya Bilig, Tomoya Oku, Yoshio Furusho, Yasuhito Koyama, Shigeo Asai and Toshikazu Takata, *Macromolecules*, **41**[22], 8496 ~ 8503 (2008)

2) Review & Book

- (1) Novel Concept for Recycle Use of Crosslinked Polymers Utilizing Dynamic Covalent Chemistry, Toshikazu Takata, Yasuhito Koyama, *Polymer (Kobunshi)*, **57**[5], 346 ~ 348 (2008)
- (2) Synthesis and Processing of Ballo Polastic, Mitsuo Akiba, Toshikazu Takata, *Plastics Japan* (September), 121~124 (2008)
- (3) Molecular Recognition and Supramolecules, Ed. by Takashi Hayashita and Hiroshi Tsukube (Chapter 10: Approaches to Supramolecular Machines), Nobuhiro Kihara, Toshikazu Takata, Sankyo Shuppan, 2008, p. 175 ~ 193

3. Invited/Plenary Talks in Conference

1) International Conference or Workshop

- (1) Graft Polyrotaxane: Synthesis, Characterization, and Properties, Toshikazu TAKATA, IUMRS-ICA2008, Nagoya, 2008.12.08-12
- (2) Movable Crosslink Polymer Network: Synthesis and Property of Polyrotaxane Networks Using An Oligocyclodextrin Crosslinker, Takayuki Arai, Toshikazu TAKATA, 2nd Japan-Korea Joint Seminar 2008 and International Symposium: Synthesis and Application of Advanced Functional Materials (JKIS 08), Tokyo, 2008.11.05
- (3) Rotaxane and Polyrotaxane Directed Toward Molecular Motor, Catalyst, and Supramolecular Gel, Toshikazu TAKATA, Institute of Chemistry, Chinese Academy of Science, Beijing, 2008.10.29
- (4) Development of Novel Fluorene-based Polymers Directed Toward Optical Application, Toshikazu

TAKATA, 5th International Symposium on High-tech Polymer Materials (HTPM-V), Beijing, 2008.10.25-28

- (5) New Aspects of Crown Ether-sec-Ammonium Rotaxane: Significant Roles in Biological and Material Sciences, Toshikazu TAKATA, Kazuko NAKAZONO, and Yasuhito KOYAMA, Yamada Conference, Awaji, 2008.09.01-04
- (6) Synthesis, Properties and Application of Rotaxanes Formed by Utilizing Dynamic Covalent Bond, Toshikazu TAKATA, Universidad Autónoma de Madrid, Madrid, 2008.07.10 Graft Polyrotaxane: Synthesis, Characterization, and Properties, Toshikazu TAKATA, IUMRS-ICA2008, Nagoya, 2008.12.08-12
- (7) Movable Crosslink Polymer Network: Synthesis and Property of Polyrotaxane Networks Using An Oligocyclodextrin Crosslinker, Takayuki Arai, Toshikazu TAKATA, 2nd Japan-Korea Joint Seminar 2008 and International Symposium: Synthesis and Application of Advanced Functional Materials (JKIS 08), Tokyo, 2008.11.05
- (8) Rotaxane and Polyrotaxane Directed Toward Molecular Motor, Catalyst, and Supramolecular Gel, Toshikazu TAKATA, Institute of Chemistry, Chinese Academy of Science, Beijing, 2008.10.29
- (9) Development of Novel Fluorene-based Polymers Directed Toward Optical Application, Toshikazu TAKATA, 5th International Symposium on High-tech Polymer Materials (HTPM-V), Beijing, 2008.10.25-28
- (10) New Aspects of Crown Ether-sec-Ammonium Rotaxane: Significant Roles in Biological and Material Sciences, Toshikazu TAKATA, Kazuko NAKAZONO, and Yasuhito KOYAMA, Yamada Conference, Awaji, 2008.09.01-04
- (11) Synthesis, Properties and Application of Rotaxanes Formed by Utilizing Dynamic Covalent Bond, Toshikazu TAKATA, Universidad Autónoma de Madrid, Madrid, 2008.07.10

2) Domestic Conferences

Domestic Invited and Special Lectures: 8 Lectures

4. Patent

8 applications

5. Award

- 1) Norihito Miyagawa, Student, Poster Award, Kanto Branch Congress of Chemistry, The Chemical society Japan, Kiryu, Gunma, 2008.09.18
- 2) Akinobu Kunimoto, Student, Poster Award, Kanto Branch Congress of Chemistry, The Chemical society Japan, Kiryu, Gunma, 2008.09.18 Others

6. Others

Editor-in-Chief, Polymer Journal, 2008.06.01~