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1. Main Research Results

Synthesis of functionalized molecules and macromolecules, control of nano structure of polymer materials, and creation of novel function of polymer were widely studied.

Continued work:

(1) design and synthesis of topological gels

Novel synthetic method for poly(crown ether) was developed utilizing the characteristics of rotaxane. To avoid the accidental penetration of the propagation end into crown ether cavity leading to gelation, initial polymerization of wheel component of crown ether-based [2]rotaxane was followed by elimination of the axle moiety to give poly(crown ether) without any gelled material.

(2) design and synthesis of high performance polymers

Design and synthesis of high performance polymers having 9,9-diarylfuorene moieties in the main chain. Diarylfuorene is characterized by its *cardo* structure affecting polymer solubility, thermal stability, optical properties. New monomer 9,9-diaryl-9-silaefluorene was developed and applied to polyester which showed high refractive index and low birefringence in addition to high solubility and thermal stability.

New work:

(3) design and synthesis of stable artificial helical polymers

Design of helical molecules having large cavity of which size is freely controlled was studied and novel helical polymers were prepared.

(4) main chain structure of polyacetylene main chain and its dynamic change

Polyacetylene having rotaxane side chains was prepared and its main chain structure was studied mainly based on the results of Raman spectra characteristic of *cis* and *trans* main chain structures. Dynamic change from *cis* to *trans* was observed.

2. List of Publication

<Original Paper>

- 1) One-Pot Synthesis of Main Chain-Type Polyrotaxane Containing Cyclodextrin Wheels, Takayuki Arai, Toshikazu Takata, *Chem. Lett.*, **36**[3], 418 ~ 419 (2007)
- 2) Tributylphosphane-Catalyzed Condensation of Alcohol and Carboxylic Acid with DCC Directed toward to Rotaxane Synthesis, Yoshimasa Makita, Nobuhiro Kihara, Toshikazu Takata, *Chem. Lett.*, **36**[1], 102 ~ 103 (2007)
- 3) Main Chain-Type Polyrotaxane with Controlled Ratio of Rotaxanated Units, Toshikazu Takata, Yasuhiro Kohsaka, Gen-ichi Konishi, *Chem. Lett.*, **36**[2], 292 ~ 293 (2007)
- 4) Catalytic Asymmetric Synthesis and Optical Resolution of Planar Chiral Rotaxane, Yoshimasa Makita, Nobuhiro Kihara, Naohisa Nakakoji, Toshikazu Takata, Shinji Inagaki, Chiyo Yamamoto, Yoshio Okamoto, *Chem. Lett.*, **36**[2], 162 ~ 163 (2007)
- 5) Solvent-Free Synthesis of Unmodified Cyclodextrin-Based Pseudopolyrotaxane and

- Polyrotaxane by Grinding, Runtao Liu, Akira Harda, Toshikazu Takata, *Polym. J.*, **39**[1], 21 ~ 23 (2007)
- 6) Extraordinary Carbon Filler-Dispersing Power of Fluorene-based Polymers as Matrix Resins, Shinichi Kawasaki, Masahiro Yamada, Kana Kobori, Mitsuaki Yamada, Terumitsu Kakumoto, Atsuyoshi Tarutani, Toshikazu Takata, *Polym. J.*, **39**[2], 115 ~ 117 (2007)
 - 7) Effect of Steric Barrier on the Shuttling of Rotaxane Having Crown Ether Wheel, Nobuhiro Kihara, Yoshifumi Koike and Toshikazu Takata, *Chem. Lett.* **36**[2], 208 ~ 209 (2007)
 - 8) Rotaxane as An Effective Scaffold: Synthesis of [3]Rotaxane and Connection of The Wheel Components Arranged on The Axle, Takashi Sato, Toshikazu Takata, *Tetrahedron Lett.*, **48**[], 2797 ~ 2801 (2007)
 - 9) Synthesis of Novel Polyrotaxanes and Formation of Polyrotaxane Network using Polyrotaxane Crosslinker, Masahiro Shioya, Toshikazu Takata, *Network Polymer*, **28**[1], 2 ~ 9 (2007)
 - 10) Solvent-Free Synthesis of Pseudopolyrotaxane and Polyrotaxane: Efficient Threading Complexation of Cyclodextrin Wheel and Linear Polymer Axle to Yield Pseudopolyrotaxane and Its Fixation to Polyrotaxane by Direct Grinding of A Solid Mixture, Toshikazu Takata, Runtao Liu, Takeshi Maeda, Nobuhiro Kihara, Akira Harada, *J. Polym. Sci., Part A: Polym. Chem.*, **45**[], 1571 ~ 1574 (2007)
 - 11) Synthesis of Rotaxanes Consisting of Crown Ether Wheel and *sec*-Ammonium Axle under Basic Condition, Kazuko Nakazono, Toshikazu Takata, *Tetrahedron Lett.*, **48**[], 3409 ~ 3411 (2007)
 - 12) Synthesis and Characterization of Novel Poly(arylene thioether)s Containing Fluorene unit with High Solubility and Thermal stability, Surasak Seesukphronrarak, Toshikazu Takata, *J. Polym. Sci., Part A: Polym. Chem.*, **45**[], 3073 ~ 3082 (2007)
 - 13) Synthesis of Properties of Fluorene-Containing Poly(arylene sulfone)s, Surasak Seesukphronrarak, Kanako Kobori, Shinichi Kawasaki, Toshikazu Takata, *Polym. J.*, **39**[7], 731 ~ 736 (2007)
 - 14) Synthesis and Chemical, Physical, and Optical Properties of 9,9-Diarylfuorene-Based Poly(ether-ether-ketone), Shinichi Kawasaki, Masahiro Yamada, Kana Kobori, Fengzhe Jin, Yoshikazu Kondo, Hideki Hayashi, Yuichi Suzuki, and Toshikazu Takata, *Macromolecules*, **40**[], 5284 ~ 5289 (2007)
 - 15) Synthesis of A Main Chain-Type Polyrotaxane Consisting of Poly(crown ether) and *sec*-Ammonium Salt Axle and Its Application to Polyrotaxane Network, Yasuhiro Kohsaka, Gen-ichi Konishi, Toshikazu Takata, *Polym. J.*, **39**[8], 861 ~ 873 (2007)
 - 16) Synthesis of Poly[2]rotaxane by Sonogashira Polycondensation, Hisahiro Sasabe, Norihiro Inomoto, Nobuhiro Kihara, Akiya Ogawa, Toshikazu Takata, *J. Polym. Sci., Part A: Polym. Chem.*, **45**[], 4154 ~ 4160 (2007)
 - 17) Novel Fluorene-based Biphenolic Monomer: 9,9-Bis(4-hydroxyphenyl)-9-silafuorene, Surasak Seesukphronrarak, Toshikazu Takata, *Chem. Lett.*, **36**[8], 1138 ~ 1139 (2007)

- 18) Reaction of Copper(II) Complexes with Na₂S₂. An Alternative Method for the Preparation of Disulfido-Dicopper(II) Complexes, Masayuki Inosako, Chizu Shimokawa, Hideki Sugimoto, Nobuhiro Kihara, Toshikazu Takata, Shinobu Itoh, *Chem. Lett.*, **36**[10], 1306 ~ 1307 (2007)
- 19) Synthesis and Structure of Optically Active Polyesters Containing C₂ Chiral Spirofluorene Moieties in the Main Chain, Ryota Seto, Takeshi Maeda, Gen-ichi Konishi, Toshikazu Takata, *Polym. J.*, **39**[], 1551 ~ 1559 (2007)
- 20) Fine Dispersion of Carbon Black in Fluorene-Based Resin, Shin-ichi Kawasaki, Masahiro Yamada, Kana Kobori, Fengzhe Jin, Toshikazu Takata, *Polymer Composites*, in press
- 21) 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, Toshikazu Takata, *J. Polym. Sci., Part A: Polym. Chem.*, in press
- 22) Synthesis of Main Chain-Type Polyrotaxane by Polymerization of Homoditopic [2]Rotaxane through Mizoroki–Heck Coupling, Takashi Sato, Toshikazu Takata, *Macromolecules*, in press.
- 23) A Novel Synthetic Route to Poly(crown ether) through Rotaxanation–Protection Protocol, Tuya Bilig, Yasuhito Koyama, Toshikazu Takata, *Chem. Lett.*, in press.

<Review>

- 1) Recent Advances on Synthesis of Cyclodextrin-Containing Polyrotaxanes, Takayuki Arai, Toshikazu Takata, *Journal of the Society of Rubber Industry, Japan*, **80**[7], 260 ~ 265 (2007).
- 2) Design and construction of photoinduced electron transfer systems based on [60]fullerene and porphyrin-containing [2]rotaxanes, Hisahiro Sasabe and Toshikazu Takata, *J. Porphyrin Phthalocyanin*, **11**[5], 334 ~ 341 (2007).

<Book>

- 1) Development of Novel Crosslink System, Toshikazu Takata, (Chapter 5, Section 5: Crosslinked Polymers Showing no Shrinkage in Volume on Crosslinking, Jyoho Kiko Publishing, Tokyo, **2007**, p. 249 ~ 260.
- 2) Frontier of Sulfur Chemicals, Toshikazu Takata (Chapter 4: Synthesis of Polysulfanes (Polysulfides)), Juzo Nakayama Ed., CMC, Tokyo, **2007**, p. 44 ~ 62.
- 3) Frontier of Sulfur Chemicals, Mitsuo Akiba, Toshikazu Takata (Chapter 4: Polysulfides), Juzo Nakayama Ed., CMC, Tokyo, **2007**, p. 154 ~ 176.
- 4) Efficient Syntheses of Rotaxanes and Construction of Polyrotaxanes and Its Polymer Networks Based on The Dynamic Covalent Chemistry, Toshikazu Takata, in *BOTTOM-UP NANOFABRICATION: Supramolecules, Self-Assemblies, and Organized Films*, Katsuhiko Ariga Ed., in press (**2007**)

- 5) Molecular Recognition and Supramolecules, Nobuhiro Kihara, Toshikazu Takata, (Chapter 10: Approach to Supramolecular Machine), Hiroshi Tsukube, Takashi Hayashita Ed., Sankyo Shuppan, 2007
- 6) "Photoinduced Processes of Rotaxanes Containing Fullerene and various Electron-Donors", O. Ito, *Encyclopedia of Nanoscience and Nanotechnology*, in press **2007**.

3. Invited Lectureship in International Meeting

- 1) Takata, T., Fukasawa, K.; Sato, T. Chirality 2007 (19th International Symposium on Chiral Discrimination), San Diego, USA, July 7-9, 2007.
- 2) Takata, T., Solvent-Free Synthesis of Polyrotaxane, (Solid-State Synthesis), 10th Pacific Polymer Conference, Kobe, JAPAN, December 4-7, 2007.
- 3) Nakazono, K.; Takata, T., Crown Ether-tert-Ammonium Salt Complex Fixed as Rotaxane and Its Derivation to Neutral Rotaxane, International Symposium on Macrocyclic and Supramolecular Chemistry 2007, Salice Terme, ITALY, June 24-28, 2007.
- 4) Takata, T., Fluorene-Containing Polymers with Excellent Optical Properties, 23rd KAIST-TIT Joint Symposium (New Trend in Asian Polymer Science and Technology), November 21-24, 2007

4. Patent

4-1. Patent: 11 applications

5. Award

- 5-1. Yasuhiro Kohsaka, Student, Research Grant of Rikogaku Shinkokai (Jan. 26, 2008)
- 5-2. Yasuhito Koyama, Assistant Professor, Research Plan Award of the Society of Synthetic Organic Chemistry, Japan (Fuji Film Co. Ltd., Feb. 20, 2008)

6. International Collaboration

None

7. Others

- 7-1. Organizing Committee Member of International Meeting: 3 Meetings
- 7-2. International Advisory Member of International Meeting: 1 Meeting