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#### 1. Highlights in 2009

- 1) Synthesis of hyperbranched polymers with controlled degree of branching  
A new class of a hyperbranched polymer with 100% degree of branching has been successfully prepared by using (1-(3-phenoxypropyl)piperidine-4-one as an AB<sub>2</sub> monomer in the presence of methanesulfonic acid. A novel synthetic method of a hyperbranched polymer possessing 100% branching was successfully developed by using 3,3-dibromo-1-hexyl-5-hydroxyindolin-2-one as a monomer in the presence of sodium hydride.
- 2) Synthesis of thermally stable and high refractive index polymers  
Highly refractive and transparent polyimide (PI) containing a 3,4,8,9-tetrahydro-2,5,7,10-tetrathiaanthracene moiety in their main chains have been developed. The PI showed the highest refractive index, i.e., 1.769 at 633 nm in the PIs.
- 3) Proton exchange membranes for fuel cell application  
Sulfonated poly(ether sulfone)s containing binaphthyl units (BNSHs) were successfully prepared for fuel cell applications. BNSH-100 (IEC = 3.19 mequiv/g) showed excellent proton conductivity, which was comparable to or even higher than that of Nafion 117, over a range of 30-50% RH at 80 °C.

#### 2. Articles

##### Original articles

- 1) Synthesis of a Hyperbranched Polymer with Perfect Branching Based on Piperidine-4-one  
Macromolecules, 42, 994–1001 (2009)  
W. Sinananwanich, T. Higashihara, M. Ueda
- 2) An Alkaline-Developable, Chemically Amplified, Negative-Type  
Photosensitive Poly(benzoxazole) Resist Based on Poly(*o*-hydroxy amide), an Active  
Ester-Type Cross-Linker, and a Photobase Generator  
Macromolecules, 42, 994–1001 (2009)  
K. Mizoguchi, T. Higashihara and M. Ueda
- 3) Locally and Densely Sulfonated Poly(ether sulfone)s as Proton Exchange Membrane  
Macromolecules, 2009, 42 (4), 1161-1166  
K. Matsumoto, T. Higashihara, M. Ueda
- 4) Synthesis and characterization of highly refractive polyimides derived from

2,7-bis(4'-aminophenylenesulfanyl)thianthrene-5,5,10,10-tetraoxide and aromatic dianhydrides  
Polymer, 2009, 789-795

N-H You, Y. Suzuki, T. Higashihara, S. Ando, M. Ueda

- 5) Influence of Polymer Structure in Sulfonated Block Copoly(ether sulfone) Membranes for Fuel Cell Application  
Polym. J., 41, 332-337 (2009)  
K. Nakabayashi, K. Matsumoto, T. Higashihara, M. Ueda
- 6) Synthesis and characterization of a novel coil-rod-coil triblock copolymers comprised of regioregular poly(3-hexylthiophene) and poly(methyl methacrylate) segments  
Reactive & Functional Polymers 69, 457-462 (2009)  
T. Higashihara, M. Ueda
- 7) Direct patterning of poly(amic acid) and low-temperature imidization using a crosslinker, a photoacid generator, and a thermobase generator  
J. Polym. Sci. Part-A, Polym. Chem., 47, 3362-3369 (2009)  
T. Ogura, T. Higashihara, M. Ueda
- 8) Locally sulfonated poly(ether sulfone)s with highly sulfonated units as proton exchange membrane  
J. Polym. Sci. Part-A, Polym. Chem., 47, 3444-3453 (2009)  
K. Matsumoto, T. Higashihara, M. Ueda
- 9) An Alkaline-Developable, Negative-Working Photosensitive Polybenzoxazole Based on Poly(*o*-hydroxyamide), a Vinyl Sulfone-Type Cross-Linker, and a Novel Photobase Generator  
Macromolecules, 2009, 42, 3780-3787  
K. Mizoguchi, T. Higashihara, M. Ueda
- 10) Synthesis of Thermotropic Liquid Crystalline Polyimides with Siloxane Linkages  
Chem. Lett. 2009, 38, 716-717  
Y. Shoji, T. Higashihara, J. Watanabe, M. Ueda
- 11) Synthesis of a novel water-soluble polyamide dendrimer based on a facile convergent method  
Eur. Polym. J., 2009, 45, 1994-2001  
K. Endo, Y. Ito, T. Higashihara, M. Ueda
- 12) Highly Refractive and Photosensitive Polyimide  
J. Photopolym. Sci. & Technol., 22, 423-428 (2009)  
Y. Saito, T. Higashihara, M. Ueda
- 13) Development of Photosensitive Poly(benzoxazole) based on a Poly(*o*hydroxy amide), a Dissolution inhibitor, and a Photoacid Generator  
J. Photopolym. Sci. & Technol., 22, 429-436 (2009)

- T. Ogura, T. Higashihara, M. Ueda
- 14) Alkaline-developable, chemically amplified, negative-type photosensitive polyimide based on polyhydroxyimide, a crosslinker, and a photoacid generator  
J. Appl. Polym. Sci. 2009, 113, 3605–3611  
Y. Saito, K. Mizoguchi, T. Higashihara, M. Ueda
  - 15) Synthesis and Memory Device Characteristics of New Sulfur Donor Containing Polyimides.  
Macromolecules, 2009, 42(13), 4456-4463.  
N-H. You, C-C. Chueh, C-L. Liu, M. Ueda, W-C. Chen
  - 16) Synthesis of High-Refractive Index Polyimide Containing Selenophene Unit  
J. Polym. Sci. Part-A, Polym. Chem., 47, 4428 - 4434 (2009)  
N-H. You, N. Fukuzaki, Y. Suzuki, Y. Nakamura, T. Higashihara, S. Ando, M. Ueda
  - 17) Synthesis of Highly Refractive Polyimides Derived from  
3,6-Bis(4-aminophenylenesulfanyl)pyridazine and  
4,6-Bis(4-aminophenylenesulfanyl)pyrimidine  
N-H. You, Y. Suzuki, Y. Nakamura, T. Higashihara, S. Ando, M. Ueda  
J. Polym. Sci. Part-A, Polym. Chem., 47, 4886–4894 (2009)
  - 18) A Chemically Amplified, Negative-type Photosensitive Poly(phenylene ether ketone) (PEK) Resist Based on Ketal-protected PEK and a Photoacid Generator  
Chem. Lett. 38, 1048-1049  
Y. Saito, K. Matsumoto, T. Higashihara, M. Ueda
  - 19) Sulfonated poly(ether sulfone)s with binaphthyl units as proton exchange membranes for fuel cell application  
J. Polym. Sci. Part-A, Polym. Chem., 47, 5827-5834 (2009)  
K. Matsumoto, T. Nakagawa, T. Higashihara, M. Ueda
  - 20) A Negative-Type Photosensitive Poly(3-hexylthiophene) with Cross-Linker and Photoacid Generator  
Polym. J., 41, 808-809 (2009)  
K. Endo, T. Ogura, T. Higashihara, M. Ueda
  - 21) Synthesis of High Refractive Index Poly(thioether sulfone)s with High Abbe's Number Derived from 2,5-Bis(sulfanylmethyl)-1,4-dithiane  
Polym. J., 41, 860-865 (2009)  
Y. Suzuki, T. Higashihara, S. Ando, M. Ueda
  - 22) Sulfonated aromatic hydrocarbon polymers as proton exchange membranes for fuel cells  
Polymer, 50(23), 5341-5357 (2009).  
T. Higashihara, K. Matsumoto, M. Ueda,
  - 23) All-conjugated diblock copolymer of poly(3-hexylthiophene)-block-

poly(3-phenoxyethylthiophene) for field-effect transistor and photovoltaic applications.

*Organic Electronics*, 10(8), 1541-1548 (2009)

C-C. Chueh, T. Higashihara, J-H. Tsai, M.Ueda, W-C. Wen

- 24) Base-Catalyzed Synthesis of a 100% Hyperbranched Polymer on the Basis of an Indolin-2-one Unit

*Macromolecules*, 42 (22), 8718–8724 (2009)

W. Sinananwanich, Y. Segawa, T. Higashihara, M. Ueda

- 25) Living Anionic Polymerization of 4-Vinyltriphenylamine for Synthesis of Novel Block Copolymers Containing Low-Polydisperse Poly(4-vinyltriphenylamine) and Regioregular Poly(3-hexylthiophene) Segments

*Macromolecules*, 42 (22), 8794–8800 (2009)

T. Higashihara, M. Ueda

- 26) High refractive index polymers: fundamental research and practical Applications

*J. Mater. Chem.*, 19, 8907–8919 (2009)

J-g. Liu, M. Ueda

- 27) Chemically Amplified Photosensitive Polyimides and Polybenzoxazoles

*J. Photopolym. Sci. & Technol.*, 22, 761-771 (2009)

K. Fukukawa, M. Ueda

#### Review Article

- 1) Development of UV cured photosensitive polymers

*Adhesion Technology* 29, 1-7 (2009)

T. Hihashihara and M. Ueda

- 2) Condensation

*Network Polymers* Vol.30, No.5, 261-272 (2009)

T. Hihashihara and M. Ueda

#### 4. Invited presentation in International/domestic conference

##### International conference

- 1) Tiwan-Japan Bilateral Polymer Symposium 4/22-24 2009 Taiwan

Synthesis of a hyperbranched polymers with controlled degree of branching p-12

M.Ueda

- 2) European Polymer Congress July 12-17 2009 Graz (Austria)

Synthesis of a hyperbranched polymers with controlled degree of branching p-200

M.Ueda W. Sinananwanich

- 3) Argentine-Chile Polymer Symposium October 19-21, 2009 Cordoba (Argentina)

Development of Highly Refractive Polymers for CMOS Image Sensor and Optical Materials.

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## **5. Patent**

Total 26 (2009)