2.2.12 Laboratory : Chemistry of Biomaterials

Member :	Professor	Takano, Toshiyuki, Dr. Agric. Sci.
	Assistant Professor	Kamitakahara, Hiroshi, Dr. Agric. Sci.
	Doctor's program	3
	Master's Program	8
	Undergraduate	3
	Post-Doctoral fellow	1

A. Research Activities (2009.4-2010.3)

A-1. Main Subjects

a) Chemical syntheses of oligo- and polysaccharides and their function

Research in our laboratory encompasses the development of photo-current cellulosic materials for a new artificial photosynthesis system, the synthesis of reducing end modified cellulose derivative and its properties, the syntheses of regio-substituted oligosaccharides and their surfactant abilities, the preparation of enzyme immobilized amino-cellulose and its properties, immobilization of tannin component to cellulose, and the evaluation system of peeling reaction using cello-oligosaccharides.

b) Reactivity of lignin

The elucidation of peculiar behavior of sinapyl alcohol in the dehydrogenative polymerization (lignin formation) using γ-substituted monolignol derivatives, and the synthesis of biomimetic catalyst based on cellulose-porphyrin derivatives for monolignol polymerization are currently being investigated to obtain fundamental knowledge of the dehydrogenative polymerization of lignin. The electronic oxidation of lignin model compounds for pretreatment of Kraft pulping, the development of new analysis method for lignin main linkage (β-O-4) are also being investigated.

c) Chemical syntheses of the extractive and their utilization

Other targets of current interest include preparation of hydorolysed-tannin. We are developing a new functional synthetic polymer with galloyl group as a pendant group.

d) Chemical modification of wood

A chemical modification method of wood using super-critical carbon dioxide as a green process is also being investigated.

A-2.Publications and presentations

a) Publications

Books

- Hiroshi Kamitakahara, Fumiaki Nakatsubo, and Dieter Klemm: "Synthesis of methylated cello-oligosaccharides", Chapter 11, pp 199-211, Polysaccharide Materials: Performance by Design ACS Symposium Series 1017, Edited by Kevin Edgar, Thomas Heinze and Charles Buchanan, 2009

Original Papers

- Enomoto-Rogers, Yukiko; Kamitakahara, Hiroshi; Nakayama, Kunihiro; Takano, Toshiyuki; Nakatsubo, Fumiaki Synthesis and thermal properties of poly(methyl methacrylate)-graft-(cellobiosylamine-C15) . Cellulose (2009), 16(3), 519-530
- Enomoto-Rogers, Yukiko; Kamitakahara, Hiroshi; Takano, Toshiyuki; Nakatsubo, Fumiaki. Cellulosic Graft Copolymer: Poly(methyl methacrylate) with Cellulose Side Chains. Biomacromolecules (2009), 10(8), 2110-2117.
- Adelwohrer, Christian; Takano, Toshiyuki; Nakatsubo, Fumiaki; Rosenau, Thomas. Synthesis of 13C-Perlabeled Cellulose with more than 99% Isotopic Enrichment by a Cationic Ring-Opening Polymerization Approach.
Biomacromolecules (2009), 10(10), 2817-2822
- Yoneda, Yuko; Ebner, Gerald; Takano, Toshiyuki; Nakatsubo, Fumiaki; Potthast, Antje; Rosenau,Thomas.
Journal of Labelled Compounds and Radiopharmaceuticals (2009), 52(6), 223-226.
- Kamitakahara, H.; Funakoshi, T.; Takano, T.; Nakatsubo, F. Syntheses of 2,6-O-alkyl celluloses: Influence of methyl and ethyl groups regioselectively introduced at O-2 and O-6 positions on their solubility. Cellulose 2009, 16, (6), 1167-1178.
- Kamitakahara, H.; Funakoshi, T.; Nakai, S.; Takano, T.; Nakatsubo, F. Syntheses of 6-O-ethyl/methyl-celluloses via ring-opening copolymerization of 3-O-benzyl-6-O-ethyl/methyl-alpha-d-glucopyranose 1,2,4-orthopivalates and their structure-property relationships. Cellulose 2009, 16, (6), 1179-1185.
- Kamitakahara, H.; Nakatsubo, F. ABA- and BAB-triblock cooligomers of tri-O-methylated and unmodified cello-oligosaccharides: syntheses and structure-solubility relationship. Cellulose 2010, 17, (1), 173-186.
- Morikawa, Y.; Yoshinaga, A.; Kamitakahara, H.; Wada, M.; Takabe, K. Cellular distribution of coniferin in differentiating xylem of Chamaecyparis obtusa as revealed by Raman microscopy. Holzforschung 2010, 64, (1), 61-67.

- Tobimatsu, Y.; Takano, T.; Kamitakahara, H.; Nakatsubo, F. Studies on the dehydrogenative polymerization of monolignol beta-glycosides. Part 6: Monitoring of horseradish peroxidase-catalyzed polymerization of monolignol glycosides by GPC-PDA. Holzforschung 2010, 64, (2), 173-181
- Tobimatsu, Y.; Takano, T.; Kamitakahara, H.; Nakatsubo, F. Reactivity of syringyl quinone methide intermediates in dehydrogenative polymerization. Part 2: pH effect in horseradish peroxidase-catalyzed polymerization of sinapyl alcohol. Holzforschung 2010, 64, (2), 183-192.

Reports

- Toshiyuki Takano, A report on Anselme Payen Award Symposium in 237th ACS Natioinal meeting, Japan Tappi Journal 2009, 63, 941-943
- Toshiyuki Takano, Report of 1st EPNOE conference "Polysaccharides as a source of advanced materials, Cellulose Coummun. 2009, 16, 171-172
- Fumiaki Nakatsubo, Toshiyuki Takano, Photocurrent cellulose thin film for organic solar cell, in Akihiko Tanioka ed. A report of oversea survey of the development of wide device basesd on nano-structure by multi-dimentional/clasess processings, P157-167 (2010)

b) Conference and seminar papers presented

- The 16th Annual Meeting of the Cellulose Society of Japan (Kyoto, 2009.7.2-7.3), 3 presentations
- The 60th Annual Meeting of the Japan Wood Research Society (Miyaazaki, 2010.3.17-3.19), 2 presentations
- The 54th Lignin Symposium (Shizuoka, 2009.10.29-10.30) 3 presentations
- 239th ACS meeting (San Francisco, 2010.3.21-3.25) 2 presentations including 1 invited lecture
- EPNOE meeting Polysaccharides as a Source of Advanced Materials (Turku/Abo, 2009.9.21-24) 2 presentations including 1 invited lecture
- Frontiers in Polymer Science, 07.-09.06.2009, (Meinz, Germany) 1 presentation

A-3.Off-campus activities

Membership in academic societies

- Toshiyuki Takano : The Japan Wood Research Society (Program committee), The Cellulose Society of Japan (Kansai branch committee)

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Basic Research (C) : Takano, Toshiyuki : Biomimetic polymerization of phenol derivatives

- Basic Research (C) : Kamitakahara, Hiroshi : Precise synthesis of cellulosic block copolymers with novel functions based on their supramolecular structure

2.Other Research Grants

- JSPS Bilateral Joint Projest between Japan and Germany：Kamitakahara, Hiroshi：Development of novel pathway for cellulose derivatives with both regiospecific and blockwise substitutions and their structure-property relationships

- the research grant for Exploratory Research on Sustainable Humanosphere Science from Research Institute for Sustainable Humanosphere (RISH), Kyoto University：Kamitakahara, Hiroshi：Elucidation of aggregation structures of cellulose derivatives in aqueous media and their structure-property relationships

A-4.International cooperations and overseas activities

International meetings(country,roles)

- Kamitakahara, Hiroshi：EPNOE 2009 Polysaccharides as a Source of Advanced Materials (Finland, Invited Lecture), 239th ACS National Meeting & Exposition (USA, Invited Lecture)

International joint research, overseas research surveys

- JSPS Bilateral Joint Projest between Japan and Germany, 'Development of novel pathway for cellulose derivatives with both regiospecific and blockwise substitutions and their structure-property relationships', Kamitakahara, Hiroshi

Visiting Research Scholars

- Visiting Research Schlor　2（Germany）

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level：Basic Forest and Biomaterials Sciences II (Takano), Cellulose Chemistry (Takano), Biomass Chemistry (Takano), Laboratory Course in Forest and Biomaterials Science II (Takano, Kamitakahara), Laboratory Course in the Basic Forest and

Biomaterial Chemistry (Takano, Kamitakahara), Laboratory Course in Biomaterials Chemistry I (Takano, Kamitakahara)

- Graduate level : Scientific writing and presentation in English (Kamitakahara), Seminar in Biomaterials Chemistry (Takano, Kamitakahara), Laboratory Course in Biomaterials Chemistry (Takano, Kamitakahara)

B-2.Off-campus teaching etc.

Part-time lecturer

- Toshiyuki Takano: Kyoto Prefectural University, Faculty of Life and Enviromental Sciences, Biomass Utilization Chemistry

Open lectures, etc.

- Toshiyuki Takano: Joint seminar with Unversity, Gifu highschool, Lecture