

JOINT RESEARCH PROJECT

FINAL REPORT *For Japan-Korea Joint Research Project*

AREA	1. Mathematics & Physics ②. Chemistry & Material Science 3. Biology 4. Informatics & Mechatronics 5. Geo-Science & Space Science 6. Medical Science 7. Humanities & Social Sciences
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1. Research Title:

Development of Novel Biomaterials Based on Artificial Polypeptides

2. Term of Research: From July 1st, 2006 To June 30th, 2008

3. Total Budget

a. Financial Support by JSPS: Total amount: 2400 thousand yen

1st Year 1000 thousand yen 2nd Year 1000 thousand yen

3rd Year 400 thousand yen

b. Other Financial Support : Total amount: _____ thousand yen

4. Project Organization

a. Japanese Principal Researcher	
Name	Hiroshi Uyama
Institution / Department	Osaka University/Graduate School of Engineering
Position	Professor
b. Korean Principal Researcher	
Name	Oh Hyeong Kwon
Institution / Department	Kumoh National Institute of Technology/Department of Polymer Science and Engineering
Position	Assistant Professor

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c. List of Japanese-side Participants (Except for Principal Researcher)

Name	Institution/Department	Position
Takashi Tsujimoto	Osaka University/Graduate School of Engineering	Assistant Professor

d. List of Korean-side Participants (Except for Principal Researcher)

Name	Institution/Department	Position
Ga Young Jun	Kumoh National Institute of Technology/Department of Polymer Science and Engineering	Master Course Student
Young-Gwang Ko	Kumoh National Institute of Technology/Department of Polymer Science and Engineering	Master Course Student

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5. Number of Exchanges during the Final Fiscal Year

a. from Japan to Korea

Name	Home Institution	Duration	Host Institution
Hiroshi Uyama	Osaka University	August 6, 2006 - August 8, 2006	Kumoh National Institute of Technology
Hiroshi Uyama	Osaka University	February 11, 2007 - February 14, 2007	Kumoh National Institute of Technology
Hiroshi Uyama	Osaka University	September 16, 2007 - September 18, 2007	Kumoh National Institute of Technology
Hiroshi Uyama	Osaka University	February 28, 2008 - March 1, 2008	Kumoh National Institute of Technology
Hiroshi Uyama	Osaka University	May 18, 2008 - May 21, 2008	Kumoh National Institute of Technology
Total: <u> 5 </u> persons		Total: <u> 17 </u> man-days	

b. from Korea to Japan

Name	Home Institution	Duration	Host Institution
Oh Hyeong Kwon	Kumoh National Institute of Technology	August 29, 2006 - September 3, 2006	Osaka University
Oh Hyeong Kwon	Kumoh National Institute of Technology	December 17, 2007, December 21, 2007	Osaka University
Total: <u> 2 </u> persons		Total: <u> 11 </u> man-days	

6. Objective of Research

Poly(γ -glutamate) (PGA) is a bio-product which is secreted by *Bacillus subtilis* from fermented bean foods. Its biodegradability, nontoxicity, compatibility and edibility have made it a promising biomaterial for various uses such as health foods, moisturizers in cosmetics, hydrogels for environmental, biomedical product applications, and biodegradable packing materials. PGA is included in fermented soybean traditional foods of both countries (Japan: Natto, Korea: Chungkookjang), which are well known to be useful for health; thus PGA is a good candidate material for joint research between both countries.

Water-soluble stimulus-responsive polymers are becoming increasingly attractive for biotechnology and medicine. Among them, thermoresponsive polymers, which show a lower critical solution temperature (LCST), have widely been investigated due to their potential applications such as controlled drug delivery, biomimetic actuators, chromatographic separations, gene-transfection agents, and immobilized biocatalysts. Poly(*N*-isopropylacrylamide) (PNIPAAm) is one of the most typical thermoresponsive polymers. PNIPAAm exhibits a rapid and reversible hydration-dehydration change in response to small temperature cycles around its LCST (32 °C).

Nano-level fabrication of bio-related polymeric materials is one of the greatest promising approaches for development of biomaterials, which includes structural control of 1 to 3 dimensions. Engineerings on precise control of the primary structure of polymers as well as their nano-level fabrication are required for development of bio-related functions. In the present collaboration, new biomaterials are fabricated by amalgamation of different research fields, "Polymer synthesis (Japan)" and "Biomaterials (Korea)". In the present joint research, we develop new biomaterials based on PGA.

We plan two research projects (A) development of anti-adhesive materials and (B) development of novel cell culture substrates for cell sheet engineering on the basis of functional PGA derivatives. In project (A), electrospinning technique is used for fabrication of materials. There has been much interest in electrospinning as a convenient and straightforward process to fabricate non-woven mats of ultrafine fibrous polymers. The diameter of the electrospun fibers is often in the sub-micron range; in contrast, conventional polymer fibers are in the range of more than micron size in diameter. The small fiber diameter and non-woven morphology (apparent porous structure) give rise to large specific surface area. This is advantageous in various applications such as wound dressings, artificial blood vessels, matrices for drug delivery systems, high-performance filters and membranes, and reinforcements in composite materials. Here, organic solvent-soluble PGA derivatives with controlled biodegradability are electrospun to fabricate nanofibrous non-woven mats, which are used for anti-adhesive materials. Designed modification of PGA with appropriate hydrophobic groups provides good solubility to common organic solvents and controlled biodegradability.

In project (B), cell sheet engineering is developed by using biocompatible thermo-responsive PGAs, which are immobilized on the cell culture dishes by simple UV irradiation. Molecular design on thermoresponsive polymers based on biodegradable poly(amino acid)s, poly(*N*(ω -hydroxyalkyl) α/β -asparagine)s, obtained by reaction of poly(succinimide) (PSI) with a mixture of 5-aminopentanol and 6-aminohexanol, is used for this application. An appropriate combination of amino alcohols produced poly(*N*(ω -hydroxyalkyl) α/β -asparagine)s showing a sharp LCST in water. PGA-based thermoresponsive polymers were similarly obtained by introduction of appropriate amino alcohols. In this study, PSI was used as model poly(amino acid) for control of thermoresponsive properties.