【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Chemistry)

Title of Project：Creation of Functional Materials Using Polymer Self Assembly and Biomedical Application

Mitsuru Akashi
（Osaka University, Graduate School of Engineering, Professor）

Research Area：Polymer Chemistry
Keyword：Nano Structure Controlled Biomaterial, Polymer Thin Film, Interface, LbL

【Purpose and Background of the Research】

Polymer-polymer interaction arises strongly, even if it is weak interaction at low molecular level individually. We have reported the creation of medical materials and regular nanospace using layer by layer (LbL) assembly, taking advantages of polymer-polymer interaction. LbL method is the unique technique for thin film preparation, dipping the substrate into two kinds of polymer solutions alternatively, which associates with each other. For example, we have prepared hollow nanoparticle with biodegradable polylactides by stereocomplex formation. In 2000, we have revealed the "weak interaction", such as Van der Waals interaction, could apply to LbL method.

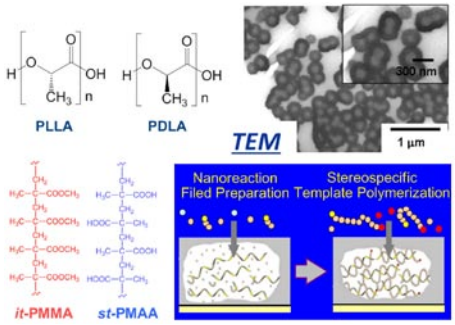

Figure 1. Nanomaterials by LbL method.

In this study, we collect the basic information on the LbL method with "weak polymer-polymer interaction", which we have firstly developed in the world. The technique is applied to create the novel safe functional materials, using biocompatible polymers with various components and substrate shapes. After the evaluation of the material functionalities, the cell experiments, the experiments *in vitro* and *in vivo*, and translational research are carried out in order to show that the polymer chemistry contributes the human society.

【Research Methods】

The LbL methods have been mainly achieved with 2 dimensional substrates. We expand the LbL materials for 0 dimensional, 1 dimensional, and 3 dimensional substrates, such as cell, tube, and various structures. The approach advantages the proper biomedical materials, shown in Figure 2.

The chemical and physical characters are analyzed for the LbL materials with biocompatible polymers, and the safety test is performed to establish technologies for translational research.

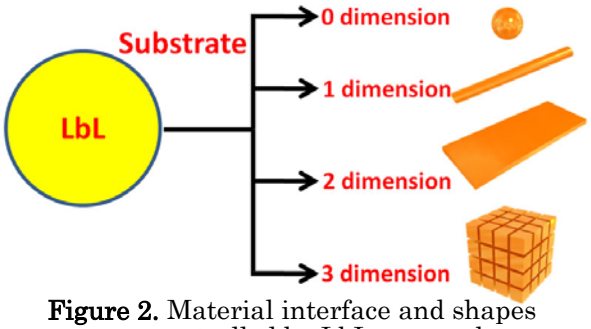

Figure 2. Material interface and shapes controlled by LbL approaches.

【Expected Research Achievements and Scientific Significance】

Important insights regarding polymer assembly are obtained. Polymer biomedical materials are fabricated, which are controlled with interface and form. The results will be utilized for novel medical treatment and future development of healthcare.

【Publications Relevant to the Project】

1. Takeshi Serizawa, Ken-ichi Hamada, Mitsuru Akashi, "Polymerization within a molecular scale stereoregular template" *Nature* **2004**, *429*, 52-55.
2. Michiya Matsusaki, Kohji Kadowaki, Yoshio Nakahara, Mitsuru Akashi, "Fabrication of cellular multilayers with nanometer-sized extracellular matrix films" *Angew. Chem. Int. Ed.* **2007**, *46*, 4689-4692.

【Term of Project】 FY2011-2015
【Budget Allocation】 163,900 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.chem.eng.osaka-u.ac.jp/~akashi-lab/