Biosystem Regulation (Biosystem Regulation)

1. Staffs and Students

Professor	Yuji MIYAHARA
Associate Professor	Akira MATSUMOTO
Assistant Professor	Tatsuro GODA
Assistant Professor	Yasuhiro MAEDA

2. Purpose of Education

(1) Charge: A part of the lecture of biomedical engineering for master's course, a part of the lecture of bio-intelligence science as a graduate education, and the research guidance of the master and the doctor's course are done.

(2) Scope: A lot of biochemical components in serum play an important role in the metabolic cycle, and the homeostasis of those concentrations appears as a result of dynamic equilibrium in the living body. When some change takes place in this metabolic pathway, concentration of biochemical component shifts from the reference value. The detection methodology of the biochemical components and control mechanism of their concentration are studied from the viewpoint of integration of the materials science and the device technology, with biological and medical science.

(3) Knowledge and the technology to be acquired: The processing methods for DNA, proteins, and cells, are acquired. The techniques for measuring the function of the biomolecules and the cells are actually experienced, and the operational theories and principles studied are confirmed. By participating in the on-going research in this laboratory, the meaning of the experiment, how to make the research plan, how to advance the research, and how to analyze the results are learnt.

3. Research Subjects

1. Study on chemical modification and nano-structure formation at the solid/liquid interface for efficient biomolecular recognition

   Interaction between materials surfaces and biomolecules, cell, and organisms plays an important role for designing many biosensors, biochips, and biomaterials. In order to realize effective biomolecular recognition on the surface of a substrate material, functional nano-interface is investigated through chemical modification and formation of nano-structures at the solid/liquid interface.

2. Study on signal transduction mechanism for biomolecular and cellular activities

   Electrostatic interaction between biomolecules and semiconductor materials and devices is investigated to elucidate mechanism for signal transduction from biomolecular recognition into electrical signals. In order to achieve compatibility between biomolecules and semiconductor materials, functional interface molecules are designed and synthesized at the bio/semiconductor interface for efficient signal transduction. Based on these studies on detection methodologies for biomolecules and cell functions, new types of bio-transistors are studied for medical and pharmaceutical applications.

3. Synthesis of biofunctional polymer and development of bio-regulation system

   Through the design of functional polymers that are able to imitate, recognize and feedback information to biology, develop novel materials and devices that assist in medicine and biology. These include alternative materials and devices to insufficiency of the body, nano-materials that realize new mode of pharmacokinetics in cells as well as live cell imaging technologies.

4. Fundamental study on Bioelectronics

   Interdisciplinary field between biotechnology and electronics is explored and investigated. Cell-based biotransistors employing signal processing inside cells are investigated for application to life science field. Information processing devices using both electrons and ions as information carriers are investigated for new types of information processing.

4.Publications

Original Articles

1. Bonanni A, Pumera M, Miyahara Y. Rapid, Sensitive, and Label-Free Impedimetric Detection of a Single-Nucleotide Polymorphism Correlated to Kidney Disease. Anal Chem 2010 MAY 1 2010:3772-9.
2. Goda T, Miyahara Y. Molecularly Engineered Charge-Conversion of Proteins for Sensitive Biosensing. Anal Chem 2010 MAR 1 8946-53.
3. Goda T, Miyahara Y. Detection of Microenvironmental Changes Induced by Protein Adsorption onto Self-Assembled

Monolayers using an Extended Gate-Field Effect Transistor. Anal Chem 2010 MAR 1 2010:1803-10.
4. Kataoka-Hamai C, Higuchi M, Iwai H, Miyahara Y. Detergent-Mediated Formation of Polymer-Supported Phospholipid Bilayers. Langmuir. 2010 SEP 21 2010:14600-5.
5. Kataoka-Hamai C, Miyahara Y. Mechanisms of supported bilayer detection using field-effect devices. Analyst. 2010 2010:189-94.
6. Matsumoto A, Cabral H, Sato N, Kataoka K, Miyahara Y. Assessment of Tumor Metastasis by the Direct Determination of Cell-Membrane Sialic Acid Expression. Angewandte Chemie-International Edition. 2010 2010:5494-7.
7. Matsumoto A, Yamamoto K, Yoshida R, Kataoka K, Aoyagi T, Miyahara Y. A totally synthetic glucose responsive gel operating in physiological aqueous conditions. Chemical Communications. 2010 2010:2203-5.
8. Scipioni R, Pumera M, Boero M, Miyahara Y, Ohno T. Investigation of the Mechanism of Adsorption of beta-Nicotinamide Adenine Dinucleotide on Single-Walled Carbon Nanotubes. Journal of Physical Chemistry Letters. 2010 JAN 2010:122-5.