Toward a Healthy Future

Almost two years have passed since we started our project "Nanotechnology Excellence, Nihon University — Nanomaterial-based Photonic, Quantum and Bio Technologies —" in the strategic research scheme, "Nihon University *N.* research project."

The purpose of our project is to contribute to find solutions for three big issues — (1) cancer, which accounts for a third of deaths in Japan, (2) shortage of fossil fuel and increase in CO_2 concentration in the atmosphere, and (3) dire need of massive and secure information processing — for a healthy future come true. These apparently diverse issues may allow common approaches from the viewpoints of nanoscience and nanotechnologies. Our approach to these issues is on the basis of nanomaterials, particularly from the view points of quantum mechanical interactions of matter with light. This interdisciplinary endeavor is being made through collaboration among practitioners in science, engineering, and medicine from five Colleges of Nihon University. The first year saw some excellent achievements, such as one in the area of super-high speed recording, which was covered as research topics in several journal articles, and another on the analysis of genetic network, which was published in *Nature*.

The second year has also seen some significant achievements. The most notable in the second year is the research on quantum information by Inoue et al. Three major achievements are that: (1) the highest rate of 2.8 kilobit in the entanglement distribution at the telecommunication wavelength to date, (2) the detection efficiency of 98.4% with their photon-number resolving detector, the highest for an optical photon detector, and (3) the fabrication of the first superconducting nanowire single photon detector. using niobium film. Some of these works have been published in *Nature Photonics* and covered by Nikkan Kogyo newspaper twice, and led to the successful granting of the Strategic Information and Communications R&D Promotion Program (SCOPE) funded by the Ministry of Internal Affairs and Communications.

In the basic nanoscience area, Otsuki visualized a rotational motion within a single molecule for the first time, which was published in *J. Am. Chem. Soc.* A research proposal on the basis of this work led to granting of the Grant-in-Aid project "Coordination Programming" from the Ministry of Education, Culture, Sports, Science and Technology. The proposed scheme was a collaborative research work among researchers in the *N.* Research Project including Otsuki, Hashiba, and Ohnuki of the College of Science and Technology (CST) and Chaen of the College of Humanities and Sciences (CHS).

We are pleased that Takano was awarded *the Shiokawa Prize* from the Rare Earth Society of Japan for his outstanding achievements in the studies of "Control of magnetism and electric conductivity for superconductors and related materials with rare-earth metal ions."

This year marked burgeoning collaborations across the college borders in a broader scale than initially planned. A good example is that quantum theorists and computation experts from the CST and the CHS have started making a program that will address problems across the border of quantum mechanics and electromagnetics by solving Schrödinger equations and Maxwell equations simultaneously.

In the medical area, as part of the originally planned collaboration between the Medical School and the CST, studies have been started on X-ray based photodynamic therapy (PDT), which will explore the

possibility of combining the effects of reactive oxygen species produced by the PDT and permeability of X-ray radiation through the tissue. Success in a preliminary test led to a patent application coauthored by researchers from the Medical School (Nagase et al.) and from the CST (Otsuki). The pharmacokinetic aspects of the newly developed reagents are being addressed by Matsumoto of the School of Pharmacy.

Itoh et al. of the CST have carried out computer-based analysis of images of stained tissues obtained by Kano et al. of the College of Bioresource Sciences in the work of cell differentiation for objective quantification of the data. New materials with controllable softness/hardness are being developed by Matsushita, formerly of CHS and now of Tokyo Institute of Technology, as substrates for cell culture for Kano's cells as he found that the surroundings are crucially important for cell differentiation processes.

Training younger generation researchers is another important objective of our project. Seven post-doctoral fellows and 5 research assistants are working with financial support from the Project. More than 100 researchers including students participated in The Second Symposium, which was held on September 18, 2010 in Funabashi, with the theme: *Fly Up, the Young Researchers from the N. Research*. Good news is that 6 students who presented their works as part of the Project were awarded excellent presentation prizes in academic meetings.

We are trying to make our research visible with various channels. Our project was covered in a booklet "Excellent University" published by University Press. We have renewed our website, through which we announce our research topics and events. Inside the university, our project was covered in five issues of Nihon University Press in a row, as well as in the October issue of Nubic News.

In addition to engaging in science and public relations activities, we have discussed what a university project should be and what we aim at beyond the goals we initially set out with. A unified theme of our research team has emerged from the discussion: toward low-carbon, healthy society through nanoscience and nanotechnology.

We are doing our best to create a center of excellence in the field of nanoscience and nanotechnology, which will be recognized in scientific communities academic and industrial, domestic and international, in three years when the Project will have been completed.

Joe Otsuki, the Principal Investigator, Feburuary 14, 2011.