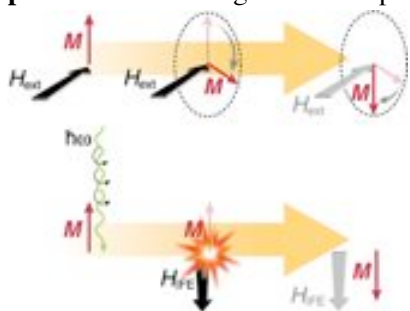


Major Achievements in 2009

Information Technology Group

A significant progress has been made on the light-induced magnetization both in theoretical insight and in experimental verification. Magnetic writing and reading were completed within 30 ps upon irradiation of a circularly polarized laser pulse. This speed corresponds to 33 Gbits s⁻¹ and is the fastest record in magnetic recording. The result was published in *Phys. Rev. Lett.*, which was **highlighted in *Physics – spotlighting exceptional research*** – published by the American Physical Society. **The best poster award** was given to the presenters in MORIS 2009.



For faster magnetic switching. *Physics* **2009**, 2, 73.

Technologies required in quantum communication are being developed at the highest standard. A high rate single photon detector was used in an experiment that achieved entangled photon pairs 10.5 km apart from each other through optical fiber. A highly efficient photon number resolving detector has been developed with a quantum efficiency of 82%. Both of these are among the best in the world.

Energy Technology Group

Some encouraging results were obtained on hydrogen evolution from water photolysis. A supramolecular complex, in which a sensitizer and a catalyst are self-assembled, produced hydrogen with an efficiency better than a system without self-assembly. Our research on artificial photosynthesis was **highlighted in magazine *someone***. An increase by 40% was recorded for hydrogen production from photosynthetic bacteria *Spirulina* in the presence of hydrogen absorbing material specifically protected from water. Lanthanum-doped titanium oxide produced hydrogen efficiently.

For fuel cell materials, an interconnector material with a high mechanical strength, a highly homogeneous proton conductor, and a highly conductive air electrode material were prepared through a newly developed nanoscale mixing procedure.

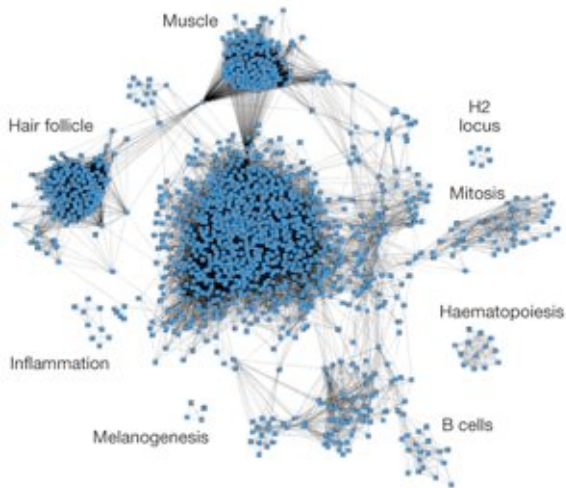
Medical Technology Group

This group applies basic research conducted by the nanoscience and nanotechnology groups (supramolecules and self-assembly group, nanomaterials and nanodevices group, and quantum theory and computation group) to the treatment of cancer.

In relation to the research on the diagnosis and therapy of cancer using synthetic organic compounds, the group investigated genetic networks and modification of genomes in normal and tumor cells exhaustively for human and animals. Part of the work has been **published in *Nature***.

Progress is being made in (1) the development of molecules for cancer diagnosis and therapy, (2) DNA binding molecules for amplified oncogene detection and silencing, (3) development of a novel

radiation dynamic therapy against cancer cells in internal organs, (4) and peptide nucleic acid molecules for over-expressed genes for disease diagnosis and therapy.



Gene expression network. *Nature* **2009**, 458, 505.

Nanoscience and nanotechnology groups

Progress is being made in the development of nanomaterials, nanostructures, and theoretical analysis on interactions between light and matter at nano scales. Emphasis was put on the development of nanostructured materials for super high density recording, single photon generation, and solar cells and compounds for DNA recognition.

A magnetized coaxial plasma gun tailored specifically for the deposition of hydrogen storage materials has been developed. Discussion is started for the joint development of a deposition instrument for commercialization with Plasmionique Inc, Canada. A low temperature plasma jet was used to polymerize membrane for biological applications. **The best poster award** was given to the presenters in the Meeting of the Institute of Engineers on Electrical Discharges in Japan 2009.

Intercollege Collaboration

A number of new collaborations are being born among researchers in different departments in this project research. For example, super high density recording media being developed by Itoh and Tsukamoto (College of Science and Technology) are fabricated using a self-assembly process, for which a technique developed by Matsushita (College of Humanities and Sciences) is used. In the development of the single photon emitter by Inoue (College of Science and Technology), single photon observation techniques of Chaen (College of Humanities and Sciences) plays a pivotal role. A part of the solar cell prototype developed by Matsushita (College of Humanities and Sciences) was fabricated with electron beam lithography by Hashiba (College of Science and Technology). The studies on the DNA targeted medicine, which are conducted chiefly by Nagase and Fukuda (School of Medicine), involve synthetic compounds prepared by Otsuki (College of Science and Technology), animal model experiments by Kano (College of Bioresource Sciences), and pharmacokinetics analysis by Matsumoto (College of Pharmacy).

Education

This team for the project includes 7 members in their 30's or younger among the total of 30 members. The project is providing them with an exciting interdisciplinary research environment. Among many research associates, PDs, doctor course students, master course students, and undergraduate students, 4 research associates, 2 PDs, 3 RAs (doctor course students) are financially supported by this project.

These research trainees of different colleges are having opportunities to interact with each other in the course of researches, project meetings, the symposium held in September, the Young Researchers Forum to be held in February, which should definitely be helpful in education through cutting-edge research, the mission which a university is meant to serve.

Collaboration with Academic and Industrial Institutions

Part of this project is collaborative research with institutions both in academic and industrial, and both in Japan and overseas.

The studies on the light triggered magnetic reversal in the Information Technology Group is carried out in collaboration with Radboud University, The Netherlands and York University, UK, among others. The work on genetic network was conducted in Helen Diller Family Comprehensive Cancer Center among other institutions. The studies by the Medical Technology Group on DNA binding molecules for amplified oncogene detection and silencing are in collaboration with Kyowa Kirin Inc., the development of a novel radiation dynamic therapy against cancer cells in internal organs are in collaboration with Utsunomiya University and Roswell Park Cancer Institute. An international travel grant was obtained from the Royal Society on the research for DNA recognition. For magnetized coaxial plasma guns developed by the Nanomaterials and Nanodevices Group, discussion is ongoing toward commercialization with Plasmionique Inc., Canada.

Publications and Achievements in 2009

Papers	159
Patents	9
Invited Lectures	76
Presentation in scientific meetings	320
Other forms	57
Award	4

It is particularly noteworthy that work on genetic network was published in *Nature*. The fastest reading/writing in magnetic recording published in *Phys. Rev. Lett.* was highlighted in *Physics – spotlighting exceptional research* – published by the American Physical Society.

The project appeared in news media *Nikkan Kogyo Shinbun* (Daily Industry Newspaper) and *Toyo Keizai* (Eastern Economy). A work toward artificial photosynthesis was highlighted in science magazine *someone*.

Best poster/presentation awards were given to contributors from the project in MORIS (Magnetics and Optics Research International Symposium) 2009 and in three domestic scientific meetings.