

Precise characterization of nanomaterials by pulsed field gradient nuclear magnetic resonance method

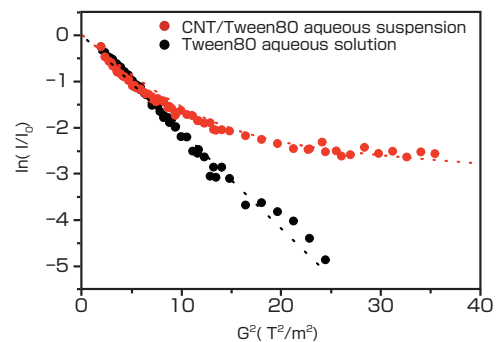
Accurate size determination and observation of diffusion phenomena of nanomaterials in solution

Pulsed field gradient nuclear magnetic resonance (PFG-NMR) spectroscopy has been developed as a method for quantitative measurements of self-diffusion coefficients of nanomaterials. It is possible to distinguish the individual diffusion components by monitoring NMR signals at different chemical shifts simultaneously.

Accurate diffusion coefficients were obtained using special NMR cells and the precise size determination of nanomaterials was accomplished by extrapolation methods varying both the concentrations of the nanomaterials and the surfactants in aqueous solution. In addition, the slow diffusions of solvent and surfactant molecules in colloidal nanoparticle aqueous dispersion were directly observed. The slow diffusions of molecules were attributed to the strongly adsorbed molecules on the nanomaterials and the amount of bound molecules was estimated (Figure). Our improved PFG-NMR method has promising potentials in the field of the characterization of functional nanomaterials and their nano-toxicity assessments.

PFG-NMR spin-echo signal attenuation plots for Tween80 molecules

The attenuation plot of Tween80 is approximately a straight line for the Tween80 aqueous solution, indicating one diffusion mode of Tween80 molecules in this solution. The observed signal decays of the Tween80 molecules were nonlinear in CNT/ Tween80 aqueous suspension, indicating some distribution of the diffusion coefficients of the Tween80 molecules. The slow diffusion of Tween80 molecules was attributed to the strongly adsorbed molecules on the CNT in the aqueous suspension.



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In Brief

President Nomakuchi's Visit to the Republic of South Africa —Workshop Held by four Research Organizations—

AIST, during the visit of Mr. Akira Amari, the then Minister of Economy, Trade and Industry to the Republic of South Africa in November, 2007, concluded a memorandum of understanding with Japan Oil, Gas and Metals National Corporation and Council for Geoscience of South Africa (CGS), and has been engaged in collaborative research on rare metal resource evaluation (article in AIST TODAY, 2008-No.28).

In September 2009, when AIST President Tamotsu Nomakuchi attended the General Assembly of the International Organization for Standardization (ISO) in Cape Town, nine AIST researchers accompanied him to Pretoria. President Nomakuchi held separate talks with the Director-General of the Department of Science and Technology and the tops of CGS, Council for Science and Industrial Research (CSIR), and Mintek. A joint workshop was also held by the four organizations.

CSIR could be seen as AIST of South Africa, and is mainly promoting "Type 2 Basic Research" centered on national projects in the fields of environment, energy, materials,

manufacturing technology, ICT, and life science. Mintek is actively engaged in industrial application research focusing around the fields of metallurgy and metallic materials. During this workshop, future research cooperation was discussed, not only in geology where research collaboration is already in operation, but also in the fields of environment, energy,



Dr. Sibusiso Sibisi, President and CEO of CSIR (back row second from right) and AIST President Nomakuchi after their meeting

nanotechnology and materials.

On the first day of the workshop, President Nomakuchi gave an opening speech, followed by overview presentations by each of the four organizations, and this deepened our understanding of each other. On the second day, working sessions in the three fields were held in which participating researchers gave research presentations that furthered our mutual understanding. There were also discussions on the possibility of research cooperation. Lastly, all participants assembled to hear reports of the sectional discussions, and discussed the overall ways of cooperation in the future.

AIST researchers also visited the research facilities of the three organizations and deepened their understanding of the research equipment and environment.

Concerning this visit to South Africa, the Embassy of Japan in South Africa greatly helped in the arrangements with the three organizations, and Mr. Toshiro Ozawa, Ambassador of Japan to the Republic of South Africa and his Embassy gave us total backup during our visit. The expectations of both government members towards AIST's research cooperation are high, and with this visit, we will further advance research cooperation with South Africa.

Thai Minister of Science and Technology Visits AIST Tsukuba —Ceremony for the Renewal of Comprehensive Memorandum of Understanding —

On October 7, 2009, Dr. Kyunying Kalaya Sophonpanich, Minister of Science and Technology of Thailand visited AIST. After exchanging views with President Nomakuchi on the research activities of AIST and science and technology, she took a tour of the Research Center for New Fuels and Vehicle Technology and Science Square Tsukuba. Dr. Sakarindr Bhumiratana, President of the National Science and Technology Development Agency of Thailand (NSTDA), and Mr. Surapol Vatanawong, Acting Governor of the Thailand Institute of Scientific and Technological Research (TISTR) were also present. A ceremony for the renewal of the comprehensive memorandum of understanding (MOU) signed 5 years ago by the two organizations and AIST was held, and the cooperation into the future was reconfirmed. There were 24 people accompanying the minister including executive officials of the Ministry of Science and Technology of Thailand, NSTDA, TISTR, members of the Royal Thai Embassy in Japan, and people of the press.

Minister Kalaya who was awarded a PhD in nuclear physics in the UK is well-versed in science and technology, and she made comments and asked questions on research activities of AIST with great interest. AIST has had active exchange with NSTDA and TISTR based on the comprehensive MOU signed on November 25, 2004. We have deepened our cooperation through exchange of researchers, Japan International Cooperation Agency (JICA) technical

trainings, management level communication, collaborative researches, and regularly held workshops (six already held), centered on environment, energy, information technology, nanotechnology, and materials. It was extremely meaningful that the renewal of the MOU was completed during the visit of Minister Kalaya.

AIST, along with NSTDA and TISTR, is working on a five-year Japan Science and Technology Agency (JST)/JICA Project "Innovation on Production and Automotive Utilization of Biofuels from Non-food Biomass" starting this year. The Thai side was much interested in such topics as the introduction of non-food biofuels in the transport sector, climate change mitigation measures, manufacturing technology of transportation fuel, engine evaluation, and fostering biofuel researchers who can work autonomously. Minister Kalaya listened attentively to the presentations at the relevant research sites of AIST.

Through this visit by the minister and the renewal of the comprehensive MOU, we reconfirmed the importance of promoting mutual collaboration. Through strengthening research collaboration between Thailand and AIST, we aim to contribute to the prevention of global warming, environmental improvement, and to solving the energy problem, as well as the economic development not only in the two countries but also in Asia.



AIST President Nomakuchi (left) and Science and Technology Minister Kalaya Sophonpanich of Thailand (right)



The renewal of the comprehensive MOU (front row from left: NSTDA President Sakarindr, AIST President Nomakuchi, TISTR Acting Governor Surapol)

Third Workshop between AIST and Department of Biotechnology of India

Under the Joint Statement Towards Japan-India Strategic and Global Partnership of December, 2006 signed by the prime ministers of India and Japan, AIST concluded a comprehensive memorandum of understanding (MOU) with the Department of Biotechnology (DBT) of the Ministry of Science and Technology of India in February, 2007. Based on this MOU, it was agreed that research cooperation would be promoted between DBT and AIST in a matching fund system in the three fields of bioinformatics, medical glycoscience, and cell engineering, and the first workshop between AIST and DBT was held in Tsukuba in January, 2008. Later, upon the project proposal of the Computational Biology Research Center, AIST, DBT publicly sought organizations in India; an international selection committee was organized; four subjects and six organizations from over 50 applications were selected; and collaborative researches were started in 2009.

At the second workshop held in Hyderabad in November, 2008, there were project proposals on medical glycoscience and cell engineering made by AIST, and exchanges have been promoted between researchers of AIST and of research organizations under DBT.





In response to these achievements, the third workshop was held in Tsukuba on October 27 and 28, 2009. For the symposium held on October 27, there were over 90 participants, and there were presentations of the research of both countries on the three topics of medical glycoscience, cell engineering, and bioinformatics. At the poster session, there was much serious discussion, and there was active

interaction among the researchers.

At the bilateral meeting held on October 28, we confirmed the specific progress made on these individual themes of collaboration, and discussed ways of further advancing the research cooperation in the future.

In bioinformatics, there were reports on the progress and future developments of the collaborative research by researchers of AIST and participating research organizations of India. In medical glycoscience and cell engineering, information exchange was started with research organizations under DBT based on the project proposal made by AIST in February, 2009. This workshop served to advance research exchange and coordination among researchers of AIST and participating research organizations of India. It was confirmed that specific research contents would be reviewed by December, 2009, and that the individual research cooperation agreements were planned to be concluded in 2009.

When the first bioinformatics project proposal was made, DBT selected research organizations through open-application in India. DBT has evaluated the results of interaction among researchers encouraged through the three workshops, and has announced that it will financially support specific parties that have already advanced research exchanges. At the same time, DBT has indicated its intentions to distribute budget likewise to universities in India which already have active ties with AIST, thus strengthening the support system for research exchange with AIST.

 **3rd Japan - India Symposium** 
on
Glycoscience, Cell Engineering & Bioinformatics
AIST, Tsukuba, Japan
October 27-28, 2009
 



Symposium attendees and logo

Cover Photos

Above: Mineral ore at Thor Lake (p. 7)

Below: The storage ring NIJI-IV dedicated to free electron lasers (p. 21)

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