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.

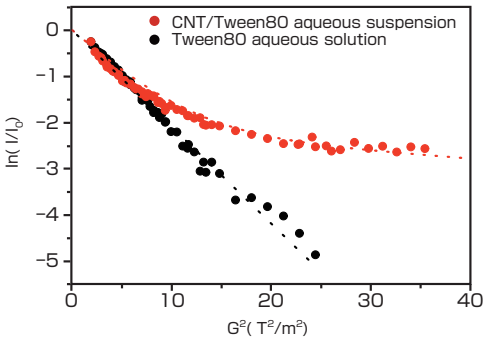
Haruhisa Kato

Metrology Institute of Japan

h-kato@aist.go.jp

AIST TODAY Vol.9 No.12 p.21 (2009)

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.



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