Susumu KUWABATA, Professor

Department of Applied Chemistry,
Graduate School of Engineering, Osaka University,
CREST, Japan Science and Technology Agency (JST)
Suita, Osaka 565-0871, Japan
Tel & FAX: +81-6-6879-7372
E-mail: kuwabata@chem.eng.osaka-u.ac.jp

Education

Dr. Eng. (March, 1991), M. Eng. (March, 1984), B. Eng. (March, 1982): Osaka University

Academic Carrier

1984 (March) - 1992 (June): Assistant Professor, Department of Applied Chemistry, Faculty of Engineering, Osaka University

1993 (June) - 1993 (May): Post-doctoral Researcher, Department of Chemistry, Colorado State University (supervisor: Prof. Charles R. Martin)

1993 (June) - 2002 (April): Associate Professor, Department of Applied Chemistry, Faculty of Engineering, Osaka University

2002 (April): Professor (Head of Laboratory of Applied Electrochemistry), Department of Applied Chemistry, Faculty of Engineering, Osaka University

2006- : Vice President of the Frontier Research Center at Faculty of Engineering, Osaka University

2008- : Director of Frontier Research Base for Global Young Researchers (Tenure-track Program Base) at at Faculty of Engineering, Osaka University

Awards and Honors

The Award for Young Chemists (The Electrochemical Society) (1992), The BCSJ Award (The Chemical Society of Japan) (2007), The Special Award for Industry-government-academia Collaboration (Nikkei Newspaper) (2007), The Awards for Creative Work (The Electrochemical Society of Japan) (2008), The Technical Achievement Award (The Surface Science Society of Japan) (2010)

Total Publications

220 original papers, 27 Review Papers, 12 books, and 27 Application of Patents

Representative Publications

"New Frontiers in Materials Science Opened by Ionic Liquids," Torimoto, T.; Tsuda, T.; Okazaki K.; Kuwabata, S., *Adv. Mater*., **22**, 1196-1221 (2010).

"Room-Temperature Ionic Liquid as New Medium for Materal Production and Analyses under Vacuum Conditiions," Kuwabata, S.; Tsuda, T.; Torimoto, T., *J. Phys. Chem. Lett.*, **1**, 3177-3188 (2010).

"Remarkable photoluminescence enhancement of ZnS-$AgInS_2$ solid solution nanoparticles by post-synthesis treatment," Torimoto, T.; Ogawa, S.; Adachi, T.; Kameyama, T.; Okazaki, K.; Shibayama, T.; Kudo, A.; Kuwabata, S., *Chem. Commun.*, **46** (12), 2082-2084 (2010).

"Systematic Studies on Emission Quenching of Cadmium Telluride Nanoparticles," Uematsu, T.; Waki, T.; Torimoto, T.; Kuwabata, S., *J. Phys. Chem. C*, **113**(52), 21621-21628 (2009).

Utilization of Room-Temperature Ionic Liquid as a New Medium under Vacuum Conditions

Susumu Kuwabata[1,3], Akihito Imanishi[2,3], and Shu Seki[1]
[1] *Department of Applied Chemistry, Graduate School of Engineering, Osaka University,*
[2] *Department of Chemistry, Graduate School of Engineering Science, Osaka University,*
[3] *JST-CREST, Kawaguchi, Saitama 332-0012, Japan*
kuwabata@chem.eng.osaka-u.ac.jp

One of fascinate features that room-temperature ionic liquid (RTIL) possesses is negligible vapour pressure, allowing us to put RTIL in a vacuum chamber. This fact would enable a desired action that is use of liquid as a sample for analytical instruments and manufacturing machines requiring vacuum conditions. Based on this idea, we are developing new techniques for nanomaterial productions and analyses by putting RTIL in vacuum chambers of several instruments.[1]

The metal sputtering instrument is widely utilized to form a metal thin layer on a solid substrate. Our attempt to subject RTIL to metal sputtering lead us to the discovery that was preparation of metal nanoparticles suspended in RTIL. This method is also useful to prepare metal alloy nanoparticles and hollow nanoparticles of metal oxide.[2]

Regarding use of RTIL for electron microscopes, the fascinate fact, which we found for the first time, is that RTIL can be observed by a scanning electron microscope (SEM) without charging of the liquid. In other words, RTIL behaves like a conducting material for SEM observation when the liquid is put on insulating samples. This fact became very useful to observe biological samples under wetted conditions. In addition, since chemical reactions including electrochemical reactions can be induced in RTIL, in situ observation of these reactions by electron microscopes is possible.[3]

SEM observation of RTIL in which sodium aurichloride was dissolved resulted in formation of gold particles with observation time. This was caused by reduction of aurichloride by irradiation of an electron beam during the SEM observation.[4] Based on this finding, we began to introduce RTIL in a focused ion beam (FIB) machine and an electron beam (EB) machine to prepare nano-patterns by inducing chemical reactions along beam scanning. As expected, metal and polymer patterns were formed by reduction of metal ions and polymerization of monomers, respectively. In the latter case, interstingly, the prepared patterns had significant thickness, which became a clue for developing the technique to prepare three-dimensional patterns by FIB in the raster scanning mode to RTIL.

References

1) Kuwabata, S.; Tsuda, T.; Torimoto, T., *J. Phys. Chem. Lett.*, **1**, 3177 (2010); Torimoto, T.; Tsuda, T.; Okazaki K.; Kuwabata, S., *Adv. Mater*., **22**, 1196 (2010).
2) Torimoto, T.; Okazaki, K.; Kiyama, T.; Hirahara, K.; Tanaka, N.; Kuwabata, S., *Appl. Phys. Lett*., **89**, 243117/1 (2006); Okazaki, K.; Kiyama, T.; Hirahara, K.; Tanaka, N.; Kuwabata, S.; Torimoto, T., *Chem. Commun.*, (6), 637 (2008); Suzuki, T.; Okazaki, K.; Suzuki, S.; Shibayama, T.; Kuwabata, S.; Torimoto, T., *Chem.Mater*., **22**, 5209 (2010).
3) Arimoto, S.; Oyamatsu, D.; Torimoto, T.; Kuwabata, S., *ChemPhysChem*, **9**, 763 (2008); Arimoto, S.; Kageyama, H.; Torimoto, T.; Kuwabata, S., *Electrochem. Commun.*, **10**, 1901 (2008).
4) Imanishi, A.; Tamura, M.; Kuwabata, S., *Chem. Commun.*,(13), 1775 (2009).