Photoelectron Spectroscopy of Ionic Liquids and Thin Films Made of Fullerenes and Their Application to Photoelectrochemistry

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Electrodes made of fullerenes and their derivatives and electrolytes containing ionic liquids (ILs) are used in the photovoltaic devices such as dye-sensitized solar cells (DSSCs) to make a breakthrough in the field of renewable energy sources. Both electronic structures and mesoscopic mixing schemes of the materials are key issues which affect their efficiency and lifetime. These structures can be investigated using a combined study of spectroscopic and thermodynamic measurements.

1. Fabrication of LB Film Electrodes of Sulfonated Fullerenes and Evaluation of Their Feasibility for the DSSCs

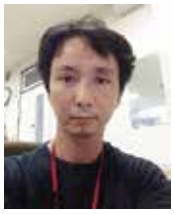
In the DSSCs, counter electrodes consist of Pt. The Pt electrode has some disadvantages such as cost and stability. Electrodes made of carbonaceous materials are candidates of substitutes for the Pt electrodes. To produce the carbon electrodes, we utilize the Langmuir-Blodgett (LB) technique. We have fabricated the LB films using fullerenes and their amphiphilic derivatives. We succeeded in producing homogeneous films on ITO glass substrates. The produced LB film electrodes were diagnosed by electrochemical methods. We found that the LB film electrodes exhibit the ionic charge- selective electron transfer (ICSET). The emergence of ICSET gives clue to utilize reactant selectivity of electrodes for suppressing side reactions which do not contribute to the efficiency of the cell.

2. Combined Study of Photoelectron Spectroscopy and Thermodynamic Measurements of ILs and Their Mixtures

We have started a research subject to apply the combined study of spectroscopic and thermodynamic measurements to the ILs. This combined study will allow us to understand the extraordinary characteristics of the ILs and their mixtures.

Observation of 3-Dimensional Nano-Structures of a Cell Nucleus

UVSOR Synchrotron Facility
Division of Beam Physics and Diagnostics Research



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Computed tomography (CT) is a powerful technique for X-ray microscopy to observe 3-dimensional internal structure of a sample without any destructive process. Additionally, by scanning the energy of X-rays, reconstructed image of CT can contain quantitative photoabsorption data to realize 3-dimensional spectroscopy. We have been developing CT for a scanning transmission X-ray microscopy (STXM) in UVSOR by designing a sample rotation cell and adjusting parameters of the optical system.[1)]

We tried 3-dimensional structural analysis of an isolated cell nucleus of $HeLaS_3$ cell. The cell nucleus was fixed by glutaraldehyde and critical point drying to maintain its morphology. 50 STXM images of the nucleus on a tungsten needle were acquired with rotating the sample 3.6° each. In data acquisition, the X-ray energy of 280 eV, below C K-edge, was used for high transmission. The dwell time was 2 ms per a point and it took ~3 hours for measurement in total. A reconstructed cross sectional image and a 3-dimensional projection image are shown in Figure 1, where a voxel size is $80\times80\times80$ nm^3. Network of actin filaments and nucleolus, round objects with high density, observed.

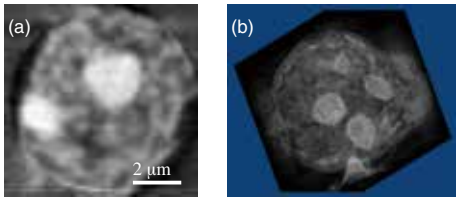

Figure 1. (a) Reconstructed cross sectional image and (b) 3-dimensional projection image of a cell nucleus.

Reference
1) T. Ohigashi *et al.*, *J. Phys.: Conf. Ser.*, in press.