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東京大学微細構造解析プラットフォーム
公開講演会

“Imaging Dynamic Materials Processes by Transmission Electron Microscopy”

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Many processes in materials science, chemistry and biology take place in a liquid environment – such as chemical conversions, the synthesis of nanoparticles, the operation of Li-ion or next generation batteries, and biological cellular functions. In many of these cases, the final desired outcome is a result of a series of complicated transients, where a change in the order, magnitude or location in each of the steps in the process can lead to a radically different result. Understanding and subsequently controlling the final outcome of the process therefore requires the ability to directly observe the transients as they happen. Aberration Corrected (Scanning) Transmission Electron Microscopy ((S)TEM) has the spatial resolution to directly visualize these transient processes on the atomic scale. However, the increased current densities caused by the correctors have made beam damage more prevalent and the limitation to imaging in many cases is now the sample rather than microscope. Similar constraints are implicit during *in-situ* or *operando* TEM experiments involving liquids, where the goal of the experiment is to observe a transient phenomenon without the beam altering the process. The aim now is therefore to more efficiently use the dose that is supplied to the sample and to extract the most information from each image. Optimizing the dose/data content in non-traditional ways (i.e. not just simply lowering the beam current) involves two main strategies to achieve dose fractionation – reducing the number of pixels being sampled in STEM mode, or increasing the speed of the images in TEM mode. For the case of the STEM, inpainting methods allow a dose reduction of an order of magnitude or more, allowing data to be automatically recorded in a compressed form. For the TEM mode of operation, an increase in speed increases the number of images and means that compressive sensing and automated methods of tracking changes in the structure need to be developed so that only the important changes need to recorded. In this presentation, results from conventional microscopes showing the use of *in-situ* liquid stages to study dynamic processes will be presented and the potential insights gained by increasing the image acquisition speed and/or decreasing the electron dose will be described. The benefits of acquiring images with a pulsed photo-emission source in the Dynamic TEM (DTEM) will also be discussed.

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Main meeting room at Institute of Engineering Innovation, UT
(工学部総合研究機構　9 号館 1 階　大会議室)
Organizer: Prof. Y. Ikuhara & Prof. N. Shibata (03-5841-7688)