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"USING SUB-SAMPLED STEM AND INPAINTING TO CONTROL THE KINETICS AND OBSERVATION EFFICIENCY OF DYNAMIC PROCESSES IN LIQUIDS"

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Dienstag, 09.01.2018, 11.00 Uhr

INM, Leibniz-Saal, Campus D2 5
Gastgeber: Prof. Dr. Niels de Jonge

Many processes in materials science, chemistry and biology take place in a liquid environment. In many of these cases, the final outcome of the process is a result of a series of complicated transients (occurring on timescales of milliseconds to nanoseconds), 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 therefore requires the ability to directly control and observe the kinetics of these transients as they happen. The spatial and temporal resolution of a transmission electron microscope (TEM) is ideally suited to study processes in liquids provided we can control the experiment sufficiently. First and foremost, we need to maintain a liquid environment in the TEM, which in recent years has become routine with the ability to purchase liquid cell stages from numerous commercial vendors. However, if we wish to acquire a time sequence of images from the same transient event using one of these stages in the TEM, the effect of the electron beam must now be taken into account – the longer the sequence of events the more the beam has an effect. In this case, to extract quantitative information free from beam artifacts, we must aim to efficiently use the dose that is supplied to the sample and to extract the most (spatial and temporal) information from each image. For the scanning (STEM) mode of operation, optimizing the dose/data content by the use of sub-sampling and inpainting can increase imaging speed, reduce electron dose by 1-2 orders of magnitude while at the same time compressing the data by the same amount. Here, we discuss the use of inpainting to generate high quality, interpretable images from sub-sampled datasets obtained from crystalline materials – the highly ordered structures allow the physical principles behind inpainting to be identified. The differences between crystalline approaches and the application of the same methods to 3-D, 4-D, spectroscopic and lower resolution in-situ images will be highlighted. New results showing the use of in-situ liquid stages to study nucleation and growth using inpainting will be presented and the potential insights that can be gained by increasing the image acquisition speed and/or decreasing the electron dose will be

described. Importantly for all in-situ observations, the kinetic control of the nucleation and growth process using sub-sampling highlights the role of the interfaces in the cell in controlling the process. Sub-sampling and inpainting is not limited to STEM as similar methods can be used in TEM mode to increase the speed of any camera. The potential to apply these methods together to extract quantitative image information from a wide range of methods will also be discussed.

This work was supported in part by the Chemical Imaging Initiative under the Laboratory Directed Research and Development Program at Pacific Northwest National Laboratory (PNNL). PNNL is a multi-program national laboratory operated by Battelle for the U.S. Department of Energy (DOE) under Contract DE-AC05-76RL01830. A portion of the research was performed using the Environmental Molecular Sciences Laboratory (EMSL), a national scientific user facility sponsored by the DOE's Office of Biological and Environmental Research at PNNL.

Wir laden 15 Minuten vor Beginn zu einem Get-together mit dem Referenten ein.

KONTAKT

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