東京大学大学院工学系研究科 総合研究機構

第13回「次世代電子顕微鏡法」講演会

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Prospects and opportunities for electron ptychography at low dose

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This lecture will describe recent developments in the use of Electron Ptychography for studies of materials, including biological structures at low electron dose.

Acquisition of a ptychographic dataset requires the collection of a series of far field diffraction patterns as a function of probe position at the specimen plane. This dataset can then be used to recover the complex specimen object function using either iterative or non-iterative algorithms. Importantly, ptychography is an inherently dose efficient technique, enabling effective phase reconstruction of radiation sensitive samples.

At low dose the sampling of the diffraction pattern in the far field is sparse and a counting direct electron detector can be operated in a binary mode to provide an effective speed increase. I will illustrate this particular application using examples of radiation sensitive mesoporous materials at frame times of 1ms. I will also highlight recent developments in optimised scanning for reduction in radiation damage.

In the life sciences Cryo-electron ptychography (Cryo-EPty) [1] holds much promise particularly when used with a defocused probe to scan across a specimen with highly overlapped probe positions. This can be applied in a variant of single particle analysis to provide 3D structures (Fig.1), taking advantage of the known resolution variation of the effective ptychographic transfer function with convergence angle (Fig. 1) to provide wide spatial frequency bandwidth transfer.

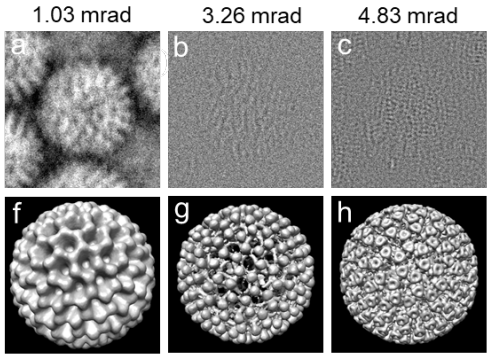

Fig.1. (a-c) Recovered ptychographic phase of a rotavirus as a function of convergence angle with corresponding 3 D density maps.

References:

[1] L. Zhou, *et al.*, Nature Communications **11**, 2773 (2020).