MONASH University

Monash Centre for Electron Microscopy

Seminar

Fluctuation Analysis of Coherent Electron Diffuse Scattering

Wednesday, 8th December 2021

10.00 – 11.00 am (AEDT)

ZOOM – Register in advance for this meeting:

https://monash.zoom.us/meeting/register/tZEvfu6rrjgjGtaCRY1Qnci4GX18cLVQYMQf

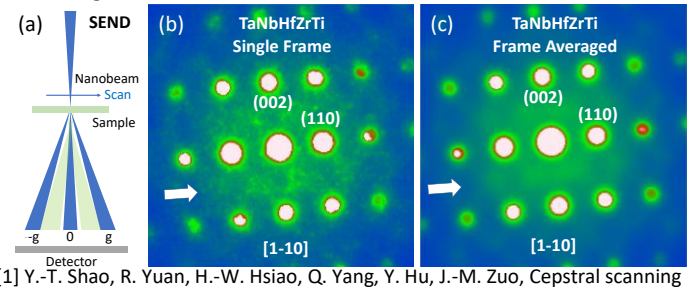
Passcode: 111111

Professor Jian-Min Zuo, Department of Materials Science and Engineering, University of Illinois, Urbana-Champaign

Abstract

Electrons diffract like X-rays and neutrons, except that the electron wavelength is very small (of the order of a few picometers), and the electron scattering cross-section is much larger, about a million times that of X-rays. Inside a transmission electron microscope (TEM), the electron beam can be focused down to <1 Å in diameter with the current reaching hundreds of picoamps (1 pA = 6.3×10^6 e/s), so the scattering power of an electron beam is much larger than that of a synchrotron. Since electron diffraction was discovered by Davisson and Germer, and Thomson and Reid, in 1927, transmission electron diffraction and the related electron imaging have developed into powerful tools for the analysis of materials, such as proteins and transistor devices. This talk will focus on the coherent diffraction aspect, and show how speckles formed by interference of electron diffuse scattering can be analyzed, and how such analysis can be applied to determine the distortive part of electron scattering potential [1].

The materials background is the study of crystal disorder. With the development of multi-principal elements alloys or high-entropy alloys, there are renewed interests in characterizing chemical and lattice disorder in these novel materials. While there is a long history of studying crystal disorder using electron diffuse scattering, quantification is always the difficult part. Here we show fluctuation analysis of coherent electron diffuse scattering overcomes these difficulties and can be applied for quantitative determination of lattice distortions and short-range ordering.



[1] Y.-T. Shao, R. Yuan, H.-W. Hsiao, Q. Yang, Y. Hu, J.-M. Zuo, Cepstral scanning transmission electron microscopy imaging of severe lattice distortions, Ultramicroscopy (2021) 113252.

The Presenter

Prof. Zuo received his Ph.D. in Physics from Arizona State University in 1989. He is currently the Racheff Professor in the Department of Materials Science and Engineering, University of Illinois, Affiliated Professor of Materials Research Laboratory and Electrical and Computer Engineering, University of Illinois. The research in Prof. Zuo's group involves the development of advanced electron microscopy for the study of structure-property relationships for novel materials characterization. He is a Fellow of American Physical Society and Microscopy Society of America, and joint author of the book, Advanced Transmission Electron Microscopy, Imaging and Diffraction in Nanoscience, and electron microdiffraction.

Convener: Professor Joanne Etheridge
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