doi:10.1017/S1431927622011928
Microsc. Microanal. 28 (Suppl 1), 2022

Precession Electron Diffraction for Electron Crystallography

Peter Moeck*

Department of Physics, Portland State University, Portland, OR, USA.
* Corresponding author: pmoeck@pdx.edu

A brief history of the precession electron diffraction technique is provided. The commercial DigiSTAR [1] implementation that can be added to any modern transmission electron microscope (TEM) in order to provide precessing primary beam capabilities is briefly mentioned. The advantages that precession electron diffraction combined with energy filtering, Fig. 1, and energy filtering alone, Fig. 2, bring to electron crystallography are discussed and demonstrated on experimental [001] and [111] diffraction spot patterns from the mineral mayenite.

A classic example of quasi-kinematic electron crystallography of a spinel nanocrystal on the basis of 267 non-overlapping and essentially featureless (blank) electron diffraction disks from a set of five approximate zone axis patterns is also discussed [2]. A novel method for the classification and quantification of the projected point symmetry of electron diffraction spot as well as blank disk patterns [3] is described. Because that method enables ultra-precise zone axis alignments, it is bound to benefit electron crystallography analyses such as the one described in [2]. Note that this new method is an extension of a recently developed information-theoretic classification and quantification method [4,5] for the plane symmetries (2D space groups and projected Laue classes) of direct space images with atomic or molecular resolution that were recorded with either transmission electron and scanning probe microscopes. The tutorial ends with the discussion of a very recent breakthrough in correcting experimental electron diffraction spot intensities for dynamical diffraction effects [6].

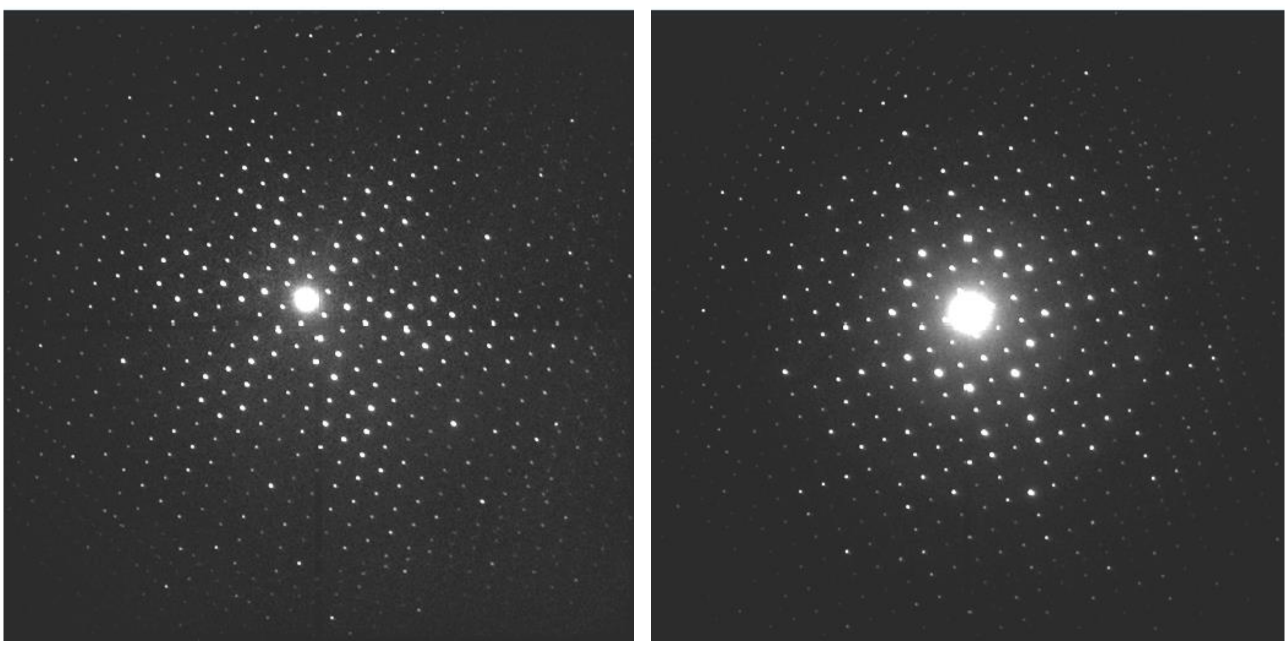

Figure 1. Energy filtered [111] (left) and [001] (right) zone axis patterns of mayenite, recorded with 3.2° precession half-angle. These patterns were obtained by Drs. Mauro Gemmi and Paola Parlanti at the Zeiss Libra 120 TEM of the Center for Nanotechnology, Istituto Italiano di Tecnologia, Pisa, Italy.

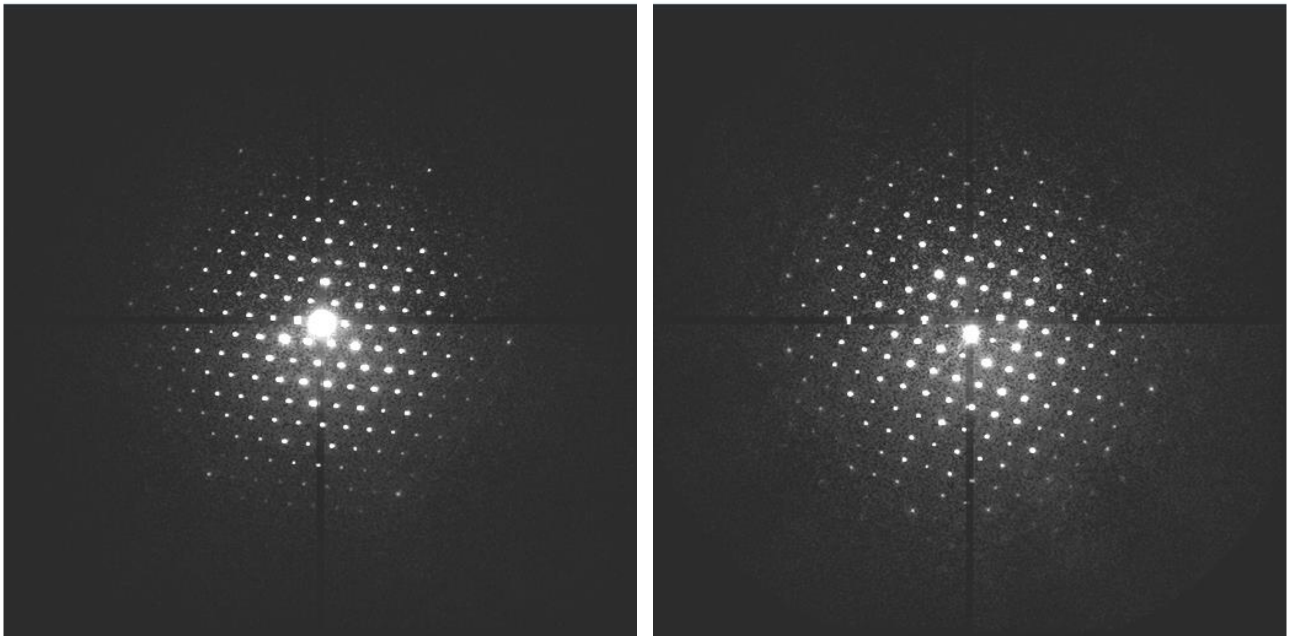

Figure 2. Approximate [111] (left) and [001] (right) zone axis patterns of mayenite, recorded without precession of the primary electron beam but with a filtering out of the inelastically scattered electrons. These patterns were obtained by Drs. Mauro Gemmi and Paola Parlanti at the Zeiss Libra 120 TEM of the Center for Nanotechnology, Istituto Italiano di Tecnologia, Pisa, Italy, from a sample different to that on which Fig. 1 is based.

References

[1] https://nanomegas.com/digistar-3/ (accessed February 15, 2022).
[2] J T McKeown and J C H Spence J. Appl. Phys. **106**, 074309 (2009).
[3] P Moeck and L von Koch, arXiv: 2202.00220, arXiv 2201.04789, Jan.-Feb. 2022, 4 pages each.
[4] P Moeck, Acta Cryst. A, **78**, 2022, in print, doi: 10.1107/S2053273322000845, expanded version arXiv: 2108.00829, Jan. 2022, 35 pages.
[5] P Moeck, Symmetry, **10**, 133 (2018).
[6] J C H Spence and J J Donatelli, Ultramicroscopy **231**, 113409 (2021).

https://doi.org/10.1017/S1431927622011928 Published online by Cambridge University Press