A Simple Program for Fast Tilting Electron-Beam Sensitive Crystals to Zone Axes

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Tilting crystals to proper zone axes is a necessary but tedious work in taking selected area electron diffraction patterns (SAED) and high-resolution images using transmission electron microscope (TEM). This process not only costs a lot of time but also limits the application of TEM in electron-beam sensitive materials. In most cases, the alignment of crystals is usually done manually by trial and error, which heavily rely on the experiences of the operator [1]. Therefore, it is desirable to develop a simple method for tilting crystals from random orientations to a specific zone axis quickly. Such a tool will prompt the study of electron-beam sensitive materials, such as zeolites and metal-organic frameworks (MOFs), as their structures cannot sustain a long-time exposure [2–4]. Kikuchi patterns under convergent-beam electron diffraction (CBED) mode have been widely used for accurately determining orientations of materials [5–8], while the high density of electrons will destroy the materials quickly. A tool “KSpaceNavigator” [9] has been developed for sample tilting in high-resolution imaging, tomography and defect analysis. Also, a method has been reported recently [10] of tilting MOFs to zone axes with assistance of computer program while it requires the range of misorientation less than ±5\textdegree. Herein, we describe a novel program, Zones, which can index the electron diffraction pattern and calculate the tilting angles of a double-tilt sample holder from the current orientation to a desired zone axis. It can also bring crystals that are slightly deviated from a zone axis to the exact zone with the help of Laue ring in the diffraction pattern. This program has been successfully applied to studies of zeolites and metal-organic frameworks (MOFs), known as being electron-beam sensitive. The program shows its power not only in saving the operator's time but also in preventing the crystals from quick beam damages.

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Figure 1. Figure 1. (a-c) Illustration of crystal tilting from one direction to another, (d-e) experimental data.

References