Poster

Electron diffraction for direct structural determination of biogenic crystals

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Biogenic crystals encompass crystals produced by living organisms. Examples include calcium oxalate crystals in plant tissues, magnetite crystals forming within diverse bacteria and animals, and various crystals within the human body. These crystals are intriguing due to their unique properties, yet extracting them from the parent organism poses challenges for structure determination. Their size range spanning from nanometers to micrometers poses challenges for determining their structures using single-crystal X-ray diffraction (SCXRD). Additionally, conducting powder X-ray diffraction (PXRD) is complicated by factors such as the small volumes of powders, crystalline impurity phases, and significant preferred orientation. In this study, we showcase the efficacy of 3D electron diffraction (3D ED) as an alternative approach. We successfully determined the structures of biogenic guanine crystals from spider integument, fish scales, and scallop eyes using an ELDICO ED-1. While electron diffraction experiments traditionally occur on transmission electron microscopes, configuring these instruments requires expertise and experiences. The ELDICO ED-1, the first dedicated electron diffractometer, has been designed to measure crystallites in the nanometer range under ambient or cryogenic conditions. With minimal electron exposure (0.01 e-/Å2/s) and a minimum beam diameter of 300 nm it is ideal for beam-sensitive materials like biogenic crystals. This research underscores the potential of 3D ED in elucidating the structures of biogenic molecular crystals, spanning nanometers to micrometers. Such insights are crucial for understanding organic biomineralization processes and the optical functions of biogenic materials. Ultimately, this knowledge can pave the way for the development of sustainable, bio-compatible optical materials.