The Structure and Micro-Structure of Biogenic Curved Single Crystals

AVIGAIL ARONHIME[1] AND BOAZ POKROY[1]

[1] Department of Material Sciences and Engineering and the Russell Berrie Nanotechnology Institute, Technion – Israel Institute of Technology, Haifa, Israel

It has been widely believed that nearly all-skeletal elements of echinoderms are single crystals . In order to achieve a curved complex structure with micrometer-size radius of curvature, devoid of facets, a special crystallization mechanism is required. In the specific case of the brittle star (O. Wendtii, of the phylum Echinodermata), it was found that the arm plates crystallize from an un-ordered amorphous precursor phase in a "mold", taking its shape .

We focused on studying the crystallography of the intricately shaped calcite plates, using EBSD and sub-micron scanning synchrotron diffractometry to show the plates are indeed single crystals. Results clearly show that the lenses and the stereom beneath are one millimeter-sized single crystal. Although this has been suggested previously using x-ray diffraction, never before has it been demonstrated with such detail.

Additionally, HRTEM measurements show nanometric intracrystalline inclusions. High-resolution synchrotron powder diffraction measurements, together with thermal and chemical analysis such as TGA, DSC and MS are used to hypothesize about the nature of these inclusions. The studied crystals exhibit very different behavior than what is commonly known about biogenic calcite, due to the presence of something other than organic molecules. We will show that this nanostructure has significant implications on the function of these lenses.