

MICROSTRUCTURE CHARACTERIZATION OF MOLLUSK SHELLS BY XRD USING AN AREA DETECTOR

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Mollusk shells are composite bioceramics made of CaCO_3 in the form of calcite and/or aragonite crystals, embedded within an organic framework. The shell is constructed with superimposed layers with the same or different mineralogical composition. The CaCO_3 crystals in different shell layers may adopt different morphologies and organise in different highly ordered configurations, or shell microstructures. The combination of a highly organized rigid mineral part and an elastic organic part confers these biomaterials superior mechanical properties, which make them ideal models for the development of new materials. To reproduce this type of materials in the laboratory it is necessary first to understand how crystals become organised in shell microstructures and to determine which factors influence their ordered assembly. However, microstructure characterization is a highly tedious process when using traditional techniques (i.e., optical or SEM microscopy and image analyses). It is especially impractical in the detailed study of a large number of samples in order to gather statistically representative information. Alternatively, the microstructure of shells can be studied much more efficiently by X-ray diffraction using area detectors available today in modern single-crystal diffractometers. The 2D diffraction patterns collected using such detectors contain detailed information about the microstructure characteristics of polycrystalline materials – crystal size, stress, crystallinity and crystallographic-texture. To understand shell microstructure development, we have combined XRD microdiffraction techniques (pole figure analyses) with high resolution SEM to follow the ordering mechanisms from the onset of crystallization. We have applied this methodology to determine the ordering mechanisms in molluscs showing the most characteristics microstructure types namely: cross-lamellar, nacre, prismatic (calcitic and aragonitic), foliated. Thus, we provide a good compilation of data which could be useful to other researchers studying textured biomaterials.