DIGS-BB SUMMER SCHOOL
Biological Making of Materials 2023

TECHNISCHE UNIVERSITÄT DRESDEN

HANDS-ON SESSION

Structural, crystallographic and mechanical analysis of biomineralized materials

Dr. Igor Zlotnikov

The formation of 3D mineral–organic functional architectures by living organisms is a tremendously active research field spanning many scientific disciplines. Classically, the topic of biomineralization was primarily the focus of earth sciences. Later, it gained the attention of researchers from different branches in chemistry and biology and currently, it is one of the most exciting topics in materials science. The cross-disciplinary interest in biomineralization stems from the efficiency of the biochemical machinery that is responsible for bottom-up biotic mineral formation, functional capacity of the mineralized tissue as a whole and, at the same time, elegance and even simplicity of the solutions it provides to the organisms. These are the main goals of current human technology.

Molluscan shells biomineralization is an exemplar system to study the process of biogenic calcium carbonate ($CaCO_3$) formation. First appearing during the Ediacaran, more than 500 million years ago, molluscs have developed hard and stiff mineralized outer shells for structural support and protection against predation. These shells consist of intricate mineral-organic composite ultrastructures made of calcium carbonates, predominately calcite and aragonite.

In this course, a number of molluscan shell ultrastructures will be studied using methods such as Scanning Electron Microscopy (SEM) for structural analysis, Raman Spectroscopy for compositional analysis, EBSD (Electron Backscatter Diffraction) for crystallographic analysis, EDS (Energy Dispersive Spectroscopy) for elemental analysis and nanoindentation for mechanical characterization. Furthermore, as part of the course, various approaches to data processing will be demonstrated. Ultimately, the participants will acquire an overview of classical methods from the domain of materials characterization and their use in the field of biological materials.