An Introduction to Biomineralization

John Dunlop

Department of Biomaterials, Max Planck Institute of Colloids and Interfaces, Potsdam-Golm

Many living organisms, ranging from bacteria to plants to animals, can control the formation of mineral both within and around their cells. These bio-minerals play important functional roles in organisms. The most obvious function is structural, with nano-sized mineral particles reinforcing our bones being a well-known example. Biominerals are also used in living systems in many other ways. To name just a few examples; they are used as transparent lenses as well as magnetic sensors and they also store important ions such as calcium used in the metabolism. All of these different functions arise through the exquisite control of the biomineralization process. Nature forms these minerals in incredibly complex shapes, with well-defined sizes and in addition can control what phase of mineral is formed (crystalline or amorphous for example). As such much research has been done to understand the process of biomineralization particularly with its application in the bioinspired design of novel materials. In medicine, and especially in the field of bone biology knowledge of how bone mineral forms is fundamental in the understanding, treatment and control of degenerative diseases such as osteoporosis.

This presentation will give a general overview of the concept of biomineralization, and its application to medicine. The idea is to firstly present the evolutionary background of minerals in biology, showing a variety of examples from all domains of life. The presentation will then focus on giving a short summary of how mineralized tissues form, and then give an overview on how minerals organisation controls the tissue mechanical properties. This will be especially focussed on mineralization processes in bone. Finally the presentation will give an overview of how an understanding of biomineralization can be used in the understanding and treatment of bone disease.

General References: