On the structure and microstructure of biogenic and biomimetic nanocomposites

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Nature is replete with materials which are superior to their man-made counterparts. More specifically, in the course of Biomineralization (the formation of minerals in nature) at least 70 biominerals are deposited. The nucleation and growth of these crystals is highly controlled via organic/inorganic interfaces.

These hybrid interfaces are present both between crystallites (intercrystalline) as well as within crystals themselves (intracrystalline). The latter have been found to induce strains in the inorganic crystal, which leads not only to deformation of the lattice but also to changes in the crystalline structure as compared to their non-biogenic counterparts.

Using high-resolution synchrotron powder diffraction we were able to measure these strains and changes in crystal structure both in biogenic as well is in biomimetic crystal. We found that upon mild annealing we can destroy these hybrid interfaces, leading to the relaxation of the strains and to the crystal structure returning to a structure identical to non-biogenic counterparts. We also found microstructural changes upon the annealing which are unique to biogenic and biomimetic crystals.

It will be shown in addition that biomimetic crystals which are grown in the lab and contain different biological molecules, exhibit the same structural and microstructural characteristics as those of biogenic crystals.

These results demonstrate that organisms can control not only the polymorph, shape and morphology, but even the crystals structure of their skeletal crystals.