COHERENT NANOPRECIPITATES WITHIN A BIOGENIC SINGLE CRYSTAL: FROM SPINODAL DECOMPOSITION TO A PRESTRESSING STRATEGY

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We recently discovered a unique biostrategy for strengthening and toughening brittle crystals of calcite [1]. Our studies on the atomic- and nano-structure of the mineralized lenses of the brittle star *Ophiocoma wendtii* revealed the presence of metastable coherent nanoprecipitates that induce compressive stress on the crystal. Although the final nanostructure is akin to the Guinier–Preston (GP)zones well known in classical metallurgy the brittle star achieves this nanostructure via a completely novel mechanism, in which crystals are formed at ambient conditions from a supersaturated amorphous precursor having coherently aligned nanoprecipitates and coherently alternating stress and elastic modulus layers. This induces compressive stress, which strengthens and toughens the mineralized tissue. In this talk I will present our study on the characterization of such crystals utilizing state-of-the-art techniques and will present the most possible mechanism of their formation both in biological and synthetic systems. [2]

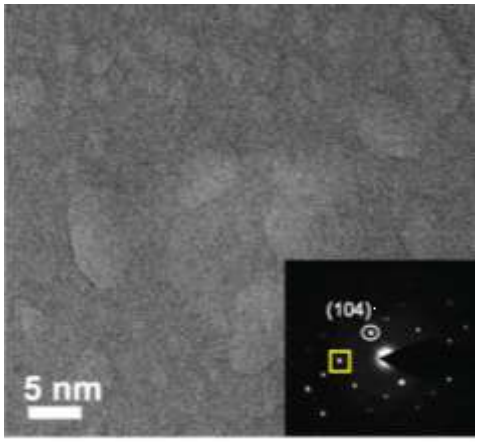

Figure 1 – HRTEM image of a thin section from a lens revealing brighter nanodomains. A lattice image undisrupted by the nanodomains, which demonstrate coherent interfaces with the lattice by the continuous lattice fringes although electron diffraction image (inset) from this area is that of a single crystal.

[1] Polishchuk I, Aronhime Bracha A, Bloch L, Levy D, Kauffmann Y, Burghammer M, Giacobbe C, Hendler G, Sun C.Y, Giuffre A.J, Marcus M.A, Katsman A, Gilbert P and Pokroy B. *Science* 2017;358;1294.

[2] Seknazi E, Kozachkevich S, Polishchuk I, Bianco Stein N, Villanova J, Suuronen JP, Dejoie C, Zaslansky P, Katsman A, Pokroy B*. *Nature Comm*. 2019. In Press.