Dislocation-assisted growth of protein/silica mesoscopic crystals in sponge spicules

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The axial filament of the giant anchor spicule of the silica sponge Monorhaphis chuni has a perfectly ordered body-centered tetragonal structure, consisting of complementary silica and protein sub-lattices [1]. This configuration occupies the volume of a slender cylindrical rod, few microns in diameter, which can reach up to 3 meters in height. Growing such a giant "colloidal crystal" must be a major challenge for any organism, and we suggest that the growth of the highly-ordered axial filament is assisted by a screw dislocation, i.e. proceeds via the classical Burton-Cabrera-Frank mechanism [2] renowned for inorganic crystals, such as e.g. silicon. In a slender rod, a screw dislocation situated along its axis produces the so called Eshelby twist of the lattice [3]. Applying microbeam X-ray diffraction and transmission electron microscopy, we did record the Eshelby twist in an axial filament of Monorhaphis chuni and mapped the dislocation deformation field. These findings strongly support the presence of screw dislocation within axial filament and an idea of the dislocation-mediated spiral growth mechanism, which is most effective at low supersaturation levels. The obtained results shed new light on the complexity of biomineralization processes.

[1] Zlotnikov, Werner, Blumtritt, Graff, Dauphin, Zolotoyabko & Fratzl (2014), *Adv. Mater.* **26**, 1682.
[2] Burton, Cabrera & Frank (1949), *Nature* **163**, 398.
[3] Eshelby (1953), *J. Appl. Phys.* **24**, 176.