Biominerals are hybrid ceramics evolutionary honed to high-performance materials with exceptional damage tolerance. Their biosynthesis typically involves the biologically-controlled crystallization of transient amorphous precursors in a shape-preserving, thus “pseudomorphic” manner. Biominerals are often praised for their exquisite control over this process, as some biominerals are known to be (nearly) single-crystalline. While earlier studies highlighted the homogenous textures of specific biominerals, complex textures are far more widespread yet challenging to account for. Here, we propose that polycrystalline biominerals with textures gradually varying with depth can be interpreted as functionally graded materials that enhance their endurance against sharp and blunt contact damage by stress delocalization [1]. We further demonstrate that spherulitic transformation bio-inspired crystallization setup readily yields such complex texture in techniques if reaction parameters are well-controlled [2]. Ultimately, a closer look at the mechanistic preconditions for spherulitic growth and the ultrastructure of ACC [3] allows for a conceptional understanding of the underlying physicochemical processes.

References