



Engineered Biomimicry: Chapter 3. Biomimetic Hard Materials

Mohammad Mirkhalaf, Deju Zhu, Francois Barthelat

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Materials such as bone, teeth, and seashells possess remarkable combinations of properties despite the poor structural quality of their ingredients (brittle minerals and soft proteins). Nacre from mollusk shells is 3,000 times tougher than the brittle mineral it is made of, a level of toughness amplification currently unmatched by any engineering material. For this reason, nacre has become the model for bio-inspiration for novel structural materials. The structure of nacre is organized over several length scales, but the microscopic brick-and-mortar arrangement of the mineral tablets is prominent. This staggered structure provides a universal approach to arranging hard building blocks in nature and is also found in bone and teeth. Recent models have demonstrated how an attractive combination of stiffness, strength, and toughness can be achieved through the staggered structure. The fabrication of engineering materials that duplicate the structure, mechanics, and properties of natural nacre still present formidable challenges to this day.

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