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High Performance Impact-Tolerant and Abrasion-Resistant Materials: Lessons from Nature

Qianqian Wang[1], James C. Weaver[1], Anthony Tantuccio[1,2], Luke Chen[1], and David Kisailus[1]

[1]Department of Chemical and Environmental Engineering, University of California, Riverside

[2]The Cooper Union for the Advancement of Science and Art, New York, New York

Our analyses of the ultrastructural and mechanical properties of mineralized biological materials have demonstrated some architectural features that help explain their observed damage tolerance[1-3]. One such example is found in the mineralized and abrasion resistant teeth of chitons, a group of marine mollusks who erode away rocky substrates on which they graze. We describe the architectural and mechanical properties of the radular teeth from *Cryptochiton stelleri* using modern microscopy and nanomechanical characterization techniques. The unique multi-phasic design of these materials contributes to their functionality and highlights some interesting design principles that might be applied to the fabrication of synthetic composites.

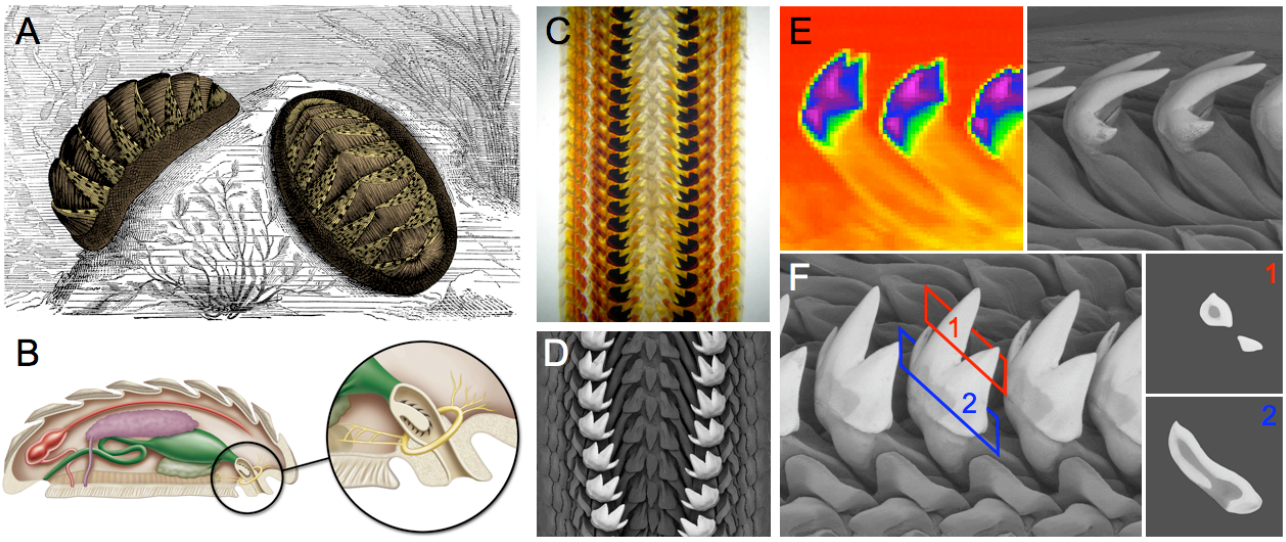

Figure 1: Morphological features of the chiton radula. External (A) and internal anatomy (B) of a representative chiton showing the location of the radula, a rasping, toothed conveyor belt-like structure used for feeding. Details of the anterior region of the radula from *C. stelleri* (C-F). Optical (C) and backscattered SEM (D) imaging and x-ray transmission studies (E) reveal the electron dense nature of the tricuspid tooth caps. Cross-sectional studies through the mature teeth from *C. stelleri* ($F_{1,2}$) reveal a concentric biphasic structure.

References

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