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Macrocomposite mechanical design, modeling, and behavior of physical models of bioinspired fish armor ASHLEY BROWNING, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, CHRISTINE ORTIZ, Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, MARY C. BOYCE, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 — The macrocomposite design of flexible biological exoskeletons, consisting of overlapping mineralized armor units embedded in a compliant tissue, is a key determinant of their mechanical function (e.g penetration resistance and biomechanical flexibility). Here, we investigate the role of macrocomposite structure, composition, geometric orientation, and spatial distribution in a flexible model natural armor system present in the majority of teleost fish species. Physical multi-material composite models are fabricated using a combination of 3-D printing and molding methods. Mechanical experiments using digital image correlation enable measurement of both the macroscopic response and underlying deformation mechanisms during various loading scenarios. Finite element-based mechanical models yield detailed insights into the roles and the tradeoffs of the composite structure providing constraint, shear, and bending mechanisms to impart protection and flexibility.

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