Artful interfaces within biological materials

Abstract

Biological materials have a wide range of mechanical properties matching their biological function. This is achieved via complex structural hierarchies, spanning many length scales, arising from the assembly of different sized building blocks during growth. The interfaces between these building blocks can increase resistance to fracture, join materials of different character, make them deform more easily and provide motility. While they represent only a tiny fraction of the overall volume, interfaces are essential for the integrity and function of the overall tissue. Understanding their construction principles, often based on specialized molecular assemblies, may change our current thinking about composite materials.

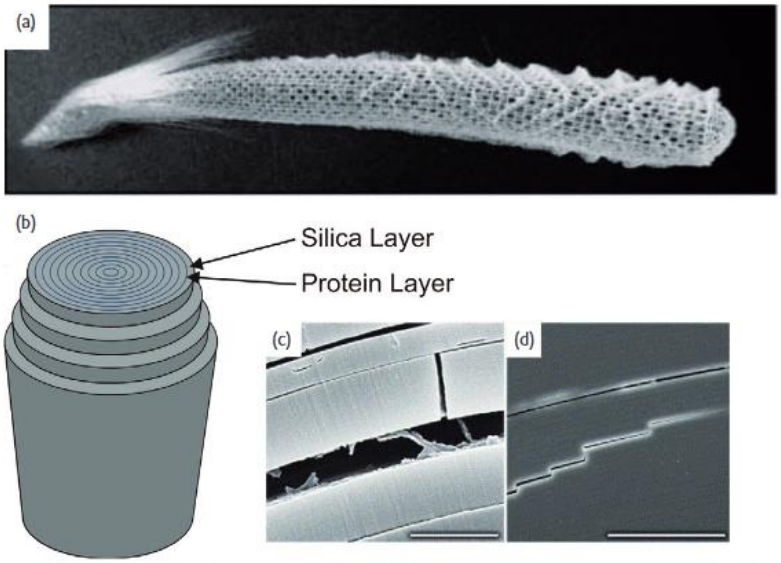

Fig. 2 (a) The glass spicules which make up the skeleton of the deep sea sponge Euplectella sp. are examples of a system in which the interfaces play an important role in improving the fracture resistance of the brittle silica. Reprinted from[12] with permission from AAAS. (b) A sketch of the cross section of one of the spicules, illustrating the concentric layers of silica separated by thin protein layers. (c) SEM image of a fracture within a layer showing the presence of soft interfacial proteins (scale bar 500 nm). (d) A macroscopic SEM micrograph of the fracture path showing crack deflection due to the soft layers (scale bar 50 μm). (c) & (d) Reprinted from[39] with permission.