Synthesis and Characterization of Bioinspired Materials Using Nanotechnology

Bandi, Sasaank

A great source of inspiration for superior quality materials comes from natural materials, like nacre, that exhibit great strengths and resilience. Nacre, known as Mother-of-Pearl, which forms up the inner lining of the shell protects the creatures within under all adversaries. The hierarchical structure of nacre resembling the brick and mortar architecture with alternating layers of organic (bio-polymer) and inorganic (aragonite) material is found to be the reason for its strength. In addition to the toughness, the resilience developed as property of such complex structure at micro and nano levels find these materials an invaluable application for body armor and other defense purposes. This research focuses on optimizing the existing process to produce desirable results. The organic layers were applied using Poly-vinylidene fluoride (PVDF) by layer-by-layer (LBL) process, while inorganic layers are formed from Alumina (Al2O3) and White Sapphire platelets via dip coating. PVDF was deposited using spin-coating or electro-spinning process. The mechanical characterization of the fabricated material was performed on custom made micro-tensile tester and optical characterization was done using SEM and AFM imaging. Mechanical properties as stress-strain responses were acquired to determine the best procedure for fabricating synthetic nacre. The procedure successfully created synthetic nacre for all trials. However, the mechanical properties for each of the samples varied significantly based on the type of platelet and the PVDF layering procedure. The spin-coated PVDF showed larger ultimate tensile strength but was less tolerant to strain, while electro spun material exhibited tolerance to 200% strain but yielded low ultimate strength.

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