the roles played by the multiple cell types involved in biological processes such as blood vessel growth.

Click here for more about the research

Nanocomposites inspired by mussels and seashells

Materials scientists from Michigan and Northwestern Universities, US, have taken a leaf out of nature's book, and developed a high-strength nanocomposite that combines the properties of nacre, or mother-of-pearl, and the marine adhesive of mussels.

Nature has evolved complex bottom-up methods for fabricating functional materials that often display incredible mechanical strength, and nacre is a wonderful example.

Nacre consists mostly of calcium carbonate, which on its own is very brittle. Yet nacre has a thousand times greater breaking strength, and this is due to a structure based on soft organic layers and lime platelets.

Paul Podsiadlo, Philip Messersmith and others prepared a nanostructured analogue of nacre from an aluminium-rich clay and a polyelectrolyte called PDDA. The mechanical strength of this material was found to be comparable with that of natural nacre and lamellar bones, but the researchers improved on this by replacing the PDDA with a polymer based on a protein adhesive secreted by mussels.

Mussel adhesive proteins (MAPs) are secreted as fluids that harden, creating a solid adhesive plaque with which the mussel bonds to various surfaces. MAPs contain an amino acid called DOPA, and this is believed to be responsible for the proteins' adhesive and cross-linking characteristics.

'The method used, layer-by-layer deposition, employs aqueous solutions of the building blocks and automated (robotic) methods, and is therefore amenable to scale-up for manufacturing of coatings on complex-shaped devices,' says Messersmith. 'In the future, it may be possible, with some additional effort, to make bulk objects of these composites, as has been done with other clay-polymer nanocomposites.'

Messersmith and his colleagues are now designing new polymer systems in which the adhesive component is at even higher concentration: 'In the mussel adhesive proteins that partially inspire these nanocomposites, the DOPA concentration approaches 30%, which is much higher than in the current study. We believe that similar DOPA concentration in our synthetic polymers may further improve mechanical performance of the nanocomposites.'

Click here for more about the research

Nautilus shell cut in half, showing the iridescent nacre lining.

Source: Wiki Commons

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