Strength is shore thing for sea shell scientists

8 March 2010

(PhysOrg.com) -- Scientists have made synthetic 'sea shells' from a mixture of chalk and polystyrene cups - and produced a tough new material that could make our homes and offices more durable.

A team of materials scientists and chemists have taken inspiration from sea shells found on the beach to create a composite material from dissimilar 'ingredients'.

Their technique could be used to make ceramics with high resistance to cracking - which could in turn be used in crack-resistant building materials and bone replacements.

Writing in the journal Advanced Materials, scientists from The University of Manchester and The University of Leeds report that they have successfully reinforced calcium carbonate, or chalk, with polystyrene particles that are used to make drinks cups.

They have developed an effective method of combining calcite crystals with polystyrene particles - and have found this makes the material more ductile compared to its original brittle form.

They report that the polystyrene also acts as a toughening agent, assisting the prevention of the growth of cracks.

Scientists also observed that when the reinforced material cracked, the polymer lengthened within the cracks - a well-known mechanism for absorbing energy and enhancing toughness.

Researchers say their method allows the properties of the new material to be tweaked by selecting particles of different shapes, sizes and composition.

Dr Stephen Eichhorn from The School of Materials at The University of Manchester, said: "The mechanical properties of shells can rival those of man-made ceramics, which are engineered at high temperatures and pressures. Their construction helps to distribute stress over the structure and control the spread of cracks.

"Calcium carbonate is the main ingredient of chalk, which is very brittle and breaks easily when force is applied. But shells are strong and resistant to fracturing, and this is because the calcium carbonate is combined with proteins which bind the crystals together, like bricks in a wall, to make the material stronger and sometimes tougher.

"We have replicated nature's addition of proteins using polystyrene, to create a strong shell-like structure with similar properties to those seen in nature.

"Further research and testing is still needed but our research potentially offers a straightforward method of engineering new and tough chalk-based composite materials with a wide range of useful applications."

More information: 'Bio-Inspired Synthesis and Mechanical Properties of Calcite-Polymer Particle Composites', *Advanced Materials*, March 2010.

Provided by University of Manchester