New, high-strength and lightweight nacre-mimetic material applicable to large-scale industrial processes

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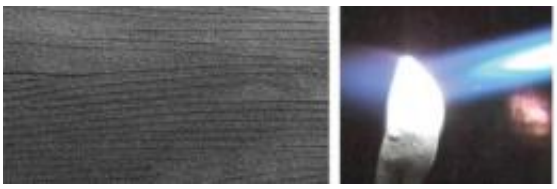

Helsinki University of Technology research group in collaboration with VTT and Royal Institute of Technology, Finland, show the first example of light-weight but mechanically strong nanocomposite material mimicking the nacreous shells that allow upscaling for industrial processes. The materials are expected to be feasible in applications where lightweight but strong materials allow particular benefits, e.g. in telecommunication, aerospace applications, and vehicles.

Nacreous shell has attracted materials scientists already long, due to its lightweight but strong structure. Mimicking nacre, the new material consists of alternating inorganic nanoscale platelets as glued by polymers, and the materials self-assemble spontaneously in a one-step process to form layered structures, using for example paper-making process, painting, and spreading.

"The new invention is based on deep understanding of self-assembly processes in material science," say PhD Andreas Walther and Academy professor Olli Ikkala who lead the project. "We have used self-assemblies and hierarchies already long in other types of materials to achieve functional properties. A good example of self-assembly is given by proteins whose chains contain in a delicate manner the information how to assemble as functional structures."

Different nanocomposite materials have already been explored extensively. However, it has remained a challenge to achieve drastically improved properties or concepts that are easily upscalable for large scale technological applications.

Lightweight and strong materials have a number applications

The new material has attracted a wide interest. The properties are easily tunable. At present it shows a tensile modulus of 45 GPa, the tensile strength of 250 MPa, it has very low gas permeation, and it shows very good properties as a thermal shield upon exposed fire. The material has been developed based on initial funding of Academy of Finland, as continued by UPM, a global forest product company, who has also a patent pending on the concept

"We believe that the material can be attractive for mobile technologies and even for flexible electronics as a support and barrier material," say Walther and Ikkala.

Upon further tailoring of the materials and the processes, the applications related to vehicles and aerospace are expected to become feasible. The lightweight but strong materials can lead to energy savings.

The nature inspires for novel high tech materials

The new material is an example of biomimetics, which aims to mimic the most attractive materials in the nature, but in simpler terms.

"The materials scientists are fascinated by the delicacy of natural materials. The properties have been developed due to the lengthy process of evolution and in some cases extraordinary properties relevant to technology can be identified. In addition to nacreous shells, the materials scientists explore for example mimics for silk, jaws, and bones."

More information: The results have been published in *Nano Letters*. DOI:10.1021/nl1003224

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