Graphene coating that changes color when deformed or cracked

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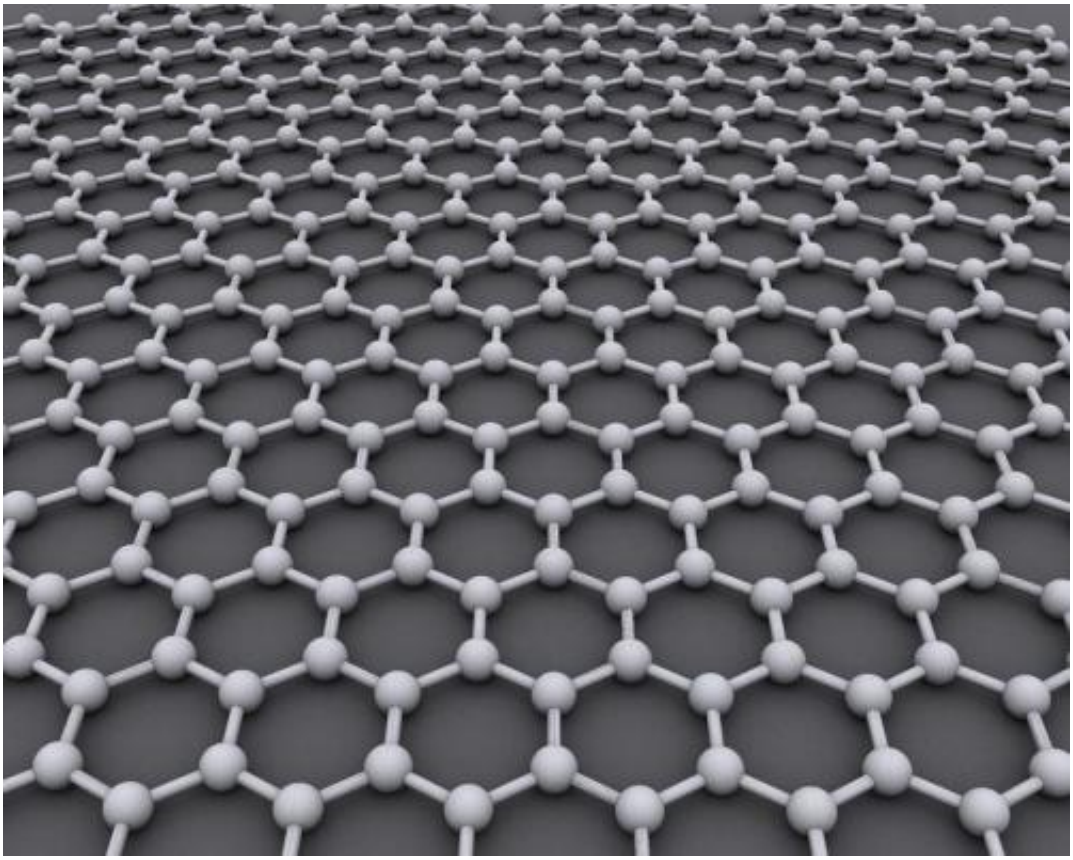

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(Phys.org)—A team of researchers at Leibniz Institute of Polymer Research in Germany has developed a graphene coating that changes color when deformed or cracked. In their paper published in the journal *Material Horizons*, the group describes how the coating is made and

suggest that it might prove useful in commercial applications.

Airplanes and bridges are just two examples of man-made structures that can appear to fail without warning. But as prior research has shown, such structures do provide warnings too tiny to see. Wings and other plane parts, for example, can develop tiny cracks which, when subjected to sudden stress, can lead to failure. In this new effort, the researchers have developed a coating for such materials that would make it much easier for inspectors to find tiny cracks that may lead to trouble.

Manmade materials are commonly colored by adding pigments—they absorb some wavelengths of light and reflect others. But nature does it another way: by growing structures that are arranged at the microscopic level in such a way as to reflect some light and to amplify or dull other light. The result can be seen in fish scales, bird feathers and even the skin of some cephalopods. To make a coating that would behave in this way, the researchers used graphene flakes that overlay parts of their neighbors. In its native state, the coating is red, but if something causes the flat surface to bend in or out, it changes to yellow—and if it becomes cracked, which cleaves the connection between flakes, it becomes green, making it relatively easy for someone looking at the material to see that it has been damaged.

Under the microscope, it is easy to see how the color changes come about—any change to the carefully placed flakes causes a change in angle causing light to bounce back in a different direction than the rest of the flakes that make up the coating. The researchers believe their coating, or one similar to it, could lead to industrial applications. But for now, more testing will be needed to determine how effective the material is at revealing deformations and cracks, and whether such a coating could stand up to real-world conditions.

More information: Yinhu Deng et al. Variable structural colouration

of composite interphases, *Mater. Horiz.* (2017). DOI: 10.1039/C6MH00559D

Abstract

Variable structural colouration results in brilliant colour changes in nature, due to the interaction of light with periodic photonic nanostructures. We report the observations of variable structural colouration from red, orange, yellow to green in a composite interphase region. By overlapping graphene nanoplatelets (GNPs) with ordered and disordered features using a special deposition approach, unique "fish scale" like structures are achieved. Variable structural colouration is observed through the mechanical tuning of fine parallel multilayers. Moreover, the method with incorporated variable structural colouration and electrical sensing functionality brings a first valuable step towards danger rating and the early warning of microcracks prior to a material's failure, using a few colours for addressing danger, alarm and safety in a "traffic light" system.