GRAPHENE OXIDE

Playing with putty

The advantage is the extremely simple preparation process, and the easy and versatile processing for construction of special architectures

The processability and large-scale production of graphene-based materials is key to promote their application; however, at present, these fabrication methods often involve complex procedures requiring stringent control of reaction conditions.

Now, Liangti Qu and colleagues report in *Advanced Materials* that the processability of graphene oxide is greatly improved when mixed with aniline, allowing the material to be moulded and printed into a diverse range of micro- and macroscale structures; from stars to elephants, many intricate structures are possible.

On mixing an aqueous solution of graphene oxide with aniline, graphene oxide balls of variable size

precipitate out of solution. These balls have the consistency of a putty-like material and can be cut in half to reveal, using microscopic techniques, a tightly packed layer structure. X-ray diffraction shows a slightly larger interlayer distance than that in graphene oxide, probably as a result of aniline molecules embedded within interlayer regions.

“The advantage is the extremely simple preparation process, and the easy and versatile processing for construction of special architectures and tailored patterns on various substrates,” says Qu. This processing method could produce graphene oxide balls as large as several centimetres in diameter, which could then be easily manipulated. Also, the putty can be placed into a household noodle-

producing machine, resulting in macroscale graphene ribbons and wires of uniform dimensions.

The viscosity of the graphene oxide putty is ideal for processing through the injector nozzles of 3D printers, and frameworks of graphene oxide are made by the researchers using this extrusion technique. Some regulation of the 3D printing process can be achieved by changing

the viscosity of the material, which in turn is controlled by altering the ratio of graphene oxide to aniline in the starting solution. Patterns of the graphene oxide putty can also be made using a laser-writing technique to remove selected regions of the material when placed on a quartz substrate.

Qu and colleagues use physical masks to form microscale interdigital electrodes on a polyethylene terephthalate (PET) substrate. The reduction of the graphene oxide comprising the interdigital electrode arrays results in fabrication of reduced graphene oxide supercapacitor devices. “These supercapacitor device arrays fabricated on these flexible PET films are generally as good as high-performance supercapacitors based on other materials,” says Qu.

“The effective regulation of the interaction between graphene oxide and the aniline molecules, which is crucial for the formation of plasticine-like materials, is a challenge,” explains Qu. There is also the question of the toxicity of aniline; however, the researchers suggest that once bonded to the graphene oxide through intermolecular interaction, the composite is stable. Indeed, the presence of aniline could be beneficial in many different device applications — if the molecule can be polymerized to form the conductive polymer, polyaniline, further enhancement of the performance of the supercapacitor may be seen.

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