Super Graphene-Skinned Materials: Concept, Synthesis and Applications

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Super graphene-skinned materials describe a new type of graphene composite materials made by directly depositing continuous graphene layers on traditional materials via chemical vapor deposition (CVD) process. By growing high-performance graphene "skin", the traditional materials are given new functionalities. The atomically thin graphene hitches a ride on the traditional material carriers to market. Beyond coating graphene powder on traditional materials, the directly-grown continuous graphene "skin" keeps its intrinsic excellent properties to a great extent, and holds the promise on future applications. Super graphene-skinned material is an innovative pathway for applications of continuous graphene films, which avoids the challenging peeling-transfer process and solves the non-self-supporting issue of ultrathin graphene film. The graphene skin almost has no influence on macroscale morphology of the supporting substrate, which leads to the high process compatibility of super graphene-skinned material in practical application scenarios. Therefore, graphene-skinned materials would exhibit their excellent performance without changing the processing of current engineering materials, and will be pushed to real industrial applications relying on the broad market of current engineering materials.

Super graphene-skinned materials can be categorized into graphene-skinned metallic materials and graphene-skinned nonmetallic materials. Depending on the different morphologies of supporting substrate materials including foil, fiber, powder, foam, etc., one can obtain graphene-skinned foil, graphene-skinned fiber, graphene-skinned powder, graphene-skinned foam, etc. Additionally, together with post-processing treatments and compositing with other materials, great versatilities can be expected for super graphene-skinned materials. A typical example is graphene-skinned glass fiber, which combines the excellent properties of graphene and glass fiber, such as the high electrical conductivity and thermal conductivity of graphene, along with the remarkable mechanical strength and flexibility of glass fiber. Graphene-skinned glass fiber presented wonderful electrothermal performances with fast heating rate and high heating uniformity, which has been successfully applied for the anti/deicing of aircraft and wind blade. The new concept of super graphene-skinned material opens up a new avenue for practical applications of continuous graphene films, strongly promotes the fusion of graphene and traditional materials, and provides new power for accelerating the graphene industry.