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Architecture and interface design for high conductive graphene/copper composites

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Recently, tailoring properties by architecture design that changes the spatial distribution of reinforcement in matrix at micro/nano-scale without changing constituents has attracted intensive attention in the community of composite. Natural biological materials are characterized by combining simple constituents into a wide variety of composites with a maximum of control over architecture on many length scales, exhibiting a remarkable range of mechanical and functional properties. Understanding the role that multilevel architectures play in controlling properties of natural materials may serve as inspirations for architecture design in composites. Metals can be strengthened by adding hard reinforcements, but such strategy usually compromises ductility and toughness as well as electrical/thermal conductivity. In past few years, a bioinspired strategy has been applied to surmount the dilemma in our research. By assembling copper nanoflakes cladded with graphene, graphene/copper matrix composites with a natural nacre inspired nanolaminated architecture have been prepared. Owing to a combined effect from the bioinspired nanolaminated architecture and improved interface bonding, a tradeoff has been made between mechanical strength and ductility as well as electrical/thermal conductivity in graphene/copper matrix composites. The bioinspired nanolaminated architecture enhances the mechanical strengthening and electrical/thermal conducting efficiencies of two-dimensional graphene by alignment of graphene that orient to maximize performance for required loading and carrier transporting conditions, and toughening by crack deflection. The strategy sheds light on the development of structural-multifunctional integrated composites.

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