Graphene and Related Layered Materials as Aerogels: Synthesis and Applications

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Aerogels are porous solids used in a wide range of applications including sorbents, filtration, insulation, hydrogen storage, catalysis, batteries, and supercapacitors. Their unique properties are related to their high internal surface, low-density, and small pore/particle size. Two-dimensional (2D) nanomaterials, such as boron nitride and graphene, also exhibit a range of distinct optical, electronic, and mechanical properties, but are typically limited to thin films and coatings. Assembling 2D nanomaterials into monolithic aerogels expands their application space to include technologies and manufacturing processes that require a macroscopic 3D form factor. Furthermore, placing the novel intrinsic properties of 2D materials in a low-density, high surface area architecture has the potential to unlock exciting new properties and features only displayed in the aerogel system. Here, we present synthesis schemes for aerogels made from several different 2D materials, (e.g. boron nitride, graphene, dichalcogenides, etc.), including hybrid aerogels, combining two or more layered materials. Applications of these novel aerogels in applications including sorbents, sensing, energy storage, and catalysis will be covered.

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