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Melamine foam-supported 3D interconnected boron nitride nanosheets network encapsulated in epoxy to achieve significant thermal conductivity enhancement at an ultralow filler loading

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Abstract: Realizing high-efficiency thermal conductivity enhancement at low filler loading has a great significance for thermally conductive composite. Herein, three-dimensional (3D) boron nitride nanosheets (BNNSs) wrapped melamine foams (MF@BNNS) were first fabricated by repeated layer-by-layer (L-B-L) assembly using melamine skeleton as substrate and BNNSs as building blocks. The resultant MF@BNNS scaffold with order and interconnected BNNS layer, as a thermally conductive network, was further infiltrated with epoxy resin. As a consequence, a relatively high thermal conductivity of 0.6 W m^{-1} K^{-1} was achieved at an ultralow BNNS loading of ~1.1 vol%, which is equivalent to a thermal conductivity enhancement of 233 % compared to epoxy resin. Besides, the obtained epoxy composite also possesses a good mechanical property and excellent electrical insulativity. This method can be further extended to construct 3D filler network of other 2D layered