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Tensile Properties and Microscopic Mechanism of Carbon Nanotube/Graphene Foam Materials

Shuai Wang[1,*] and Lihong Liang[1,*]

[1]College of Mechanical and Electrical Engineering, Beijing University of Chemical Technology, Beijing, 100029, China
[*]Corresponding Author: Shuai Wang, Lihong Liang. Email: wangshuai2021@mail.buct.edu.cn, lianglh@mail.buct.edu.cn

ABSTRACT

Compared to pure carbon nanotube (CNT) foam (CF) and pure graphene foam (GrF), the CNT/graphene composite foam show enhanced mechanical properties, using coarse-grained molecular dynamics method, the tensile and compressive properties and corresponding deformation mechanism of several typical CNT/graphene composite foams were studied. The CNT coating could enhance the bending resistance of graphene, based on the CNT-coated graphene flakes, the CNT-coated graphene foam (CCGF) is constructed, which shows better compressive modulus due to the enhanced bending resistance of CNT-coated graphene flakes compared to graphene in pure GrF [1]. CNT can enhance the mechanical properties of graphene foams not only by influencing the properties of graphene but also by enhancing the crosslinkers between graphene. The mechanical response and microscopic mechanism of GrF interconnected by both short crosslinkers and long CNTs (named CNT bonded GrF, CbGrF) under tension and compression are further studied. Under tension, the long CNTs play a reinforcing role at a larger tensile strain, leading to larger tensile strength and toughness. Under compression, the sliding and rotation of graphene flakes in CbGrF are prevented by long CNTs, resulting in higher compressive stiffness than that of pure GrFs [2]. Finally, we studied the role of graphene in the graphene-filled CNT foam (GFCF) and the corresponding microscopic deformation mechanism. It is found that the filling of graphene inhibits the aggregation of CNTs, impedes the rearrangement of CNTs and enhances the dispersion of CNTs, ultimately improves the compressive modulus of the whole material through improving the bending ability of CNTs. The results in this paper deepen the understanding of the microscopic mechanisms of CNT/graphene foam and provide scientific guidance for the application of CNT and graphene-based materials.

KEYWORDS

Carbon nanotube; graphene; foam materials; tensile and compressive properties; microscopic deformation mechanism

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References

1. Wang, S., Wang, C., Khan, M. B., Chen, S. (2021). Microscopic deformation mechanism and main influencing

factors of carbon nanotube coated graphene foams under uniaxial compression. *Nanotechnology, 32(34),* 345704.

2. Wang, S., Yang, T., Wang, C., Liang, L. H. (2023). The mechanical response and microscopic deformation mechanism of graphene foams tuned by long carbon nanotubes and short crosslinkers. *Physical Chemistry Chemical Physics, 25(1),* 192-202.