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Enhanced mechanical properties of bulk graphene/aluminum composites with a bio-inspired nanolaminated structure

Qiang Guo, Zan Li, Z. Li, G. Fan and Di Zhang
State Key Laboratory of Metal Matrix Composites, Shanghai Jiao Tong University, China

Bulk graphene-reinforced Al matrix composites of various reinforcement concentrations were fabricated via a modified powder metallurgy approach. These composites possess a nanolaminated, brick-and-mortar architecture, where layers of ~200nm-thick pure Al platelets are stacked in a staggered arrangement, and are separated by graphene sheets, each containing 4-5 graphene monolayers. The composite containing 1.5 vol. % graphene were shown to have an uniaxial tensile strength of 302±3MPa, about 50% higher than that of unreinforced Al matrix prepared using the same fabrication route (201±6MPa). Moreover, the composite possess a uniform elongation of 3.4±0.2%, only slightly lower than that of the Al matrix (4.3±0.4%), and have a significantly lower strain hardening capability. Combined with post-mortem and in situ transmission electron microscopic (TEM) analysis, our findings were interpreted in terms of the uniform distribution of graphene in the Al matrix, the effective load transfer between the graphene sheets and Al platelets, and the interaction between mobile dislocations and the graphene-Al interfaces.

Biography:

Qiang Guo received the B.Sc. degree in microelectronics from Peking University, China in 2005, and received the M.Eng. degree in materials science and engineering from Massachusetts Institute of Technology (MIT), in 2006. He obtained the PhD degree in 2010 from National University of Singapore, under the Singapore-MIT Alliance (SMA) program. Between 2010-2012, he was a postdoc in the Department of Applied Physics and Materials Science in California Institute of Technology (Caltech). Since Oct. 2012, he has been an associate professor in the School of Materials Science & Engineering, in Shanghai Jiao Tong University, China. His main research focus is the mechanical properties of micro-/nano-scaled metallic materials.