IBS Center for Multidimensional Carbon Materials

Special Guest Seminar

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Graphene-induced strengthening in metal matrix composites beyond its load-bearing effect

Aug 24
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Bldg. 101
Seminar Room on the 1st floor

Abstract:
When nano-scaled reinforcements ("nanofillers", such as CNT and graphene) are incorporated into a metal matrix, the enhancement in mechanical properties may well exceed those predicted by the "rule-of-mixtures", owing to the rich interplay between the nanofiller and the various crystalline defects in the metal matrix. However, how the nanofillers and their interfaces with the matrix affect the deformation and failure mechanisms of the composites still remains elusive. Using nanolaminated graphene-Al and graphene-Cu composites as model materials, we showed that the graphene incorporation into the metal matrix led to a significant strengthening effect, even if the graphene layers were not oriented in their load-bearing orientations. Further strain-rate dependence and stress relaxation measurements demonstrated that the graphene inclusion at the metal grain boundaries improved the dislocation storage ability in the metal grains and facilitated the dislocation-interface interactions, both of which resulted in elevated strain hardening capacity and subsequently a considerable increase in mechanical strength. The easy control and general applicability of the grain boundary engineering by extrinsic nanofillers may open a new avenue for producing nanostructured metals with enhanced mechanical properties.

Reference:
[1] Z. Li, G. Fan, **Q. Guo*** et al Carbon, 95, 419-427, 2015.
[2] Z. Li, **Q. Guo***, et al Nano Letters, 15, 8077-8083, 2015.
[3] S. Feng, **Q. Guo*** et al Acta Materialia, 125, 98-108, 2017.
[4] Z. Li, L. Zhao, **Q. Guo***, et al Scripta Materialia, 131, 67-71, 2017.
[5] L. Zhao, **Q. Guo*** et al International Journal of Plasticity, 105, 128-140, 2018.