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# Graphene Network in Copper Sulfide Leading to Enhanced Thermoelectric Properties and Thermal Stability

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## Abstract

Copper sulfide has received wide attention as a potential thermoelectric material with high performance and abundant resource. While the liquid-like Cu ions play an important role for the low  $\kappa_L$  and high  $ZT$  values, grain-boundary engineering is needed to further enhance the phonon scattering and the thermal stability of  $\text{Cu}_{2-x}\text{S}$ . Here, we introduced the 3D graphene heterointerface into the  $\text{Cu}_{2-x}\text{S}$  matrix by a facile technique combining mechanical alloying (MA) and spark plasma sintering (SPS). A significant  $ZT$  enhancement was realized with the highest  $ZT$  up to 1.56 and a high power factor of  $1197 \mu\text{W m}^{-1}\text{K}^{-2}$  at 873 K in the sample with 0.75wt% graphene. Additionally, the composite showed excellent reproducibility of  $PF$  after five cycles testing from room temperature to 873 K, which confirmed the practical application potentiality of this composite.

## Graphical abstract

The 3D graphene network is introduced into the  $\text{Cu}_{2-x}\text{S}$  matrix by a facile technique, leading to a significant  $ZT$  enhancement with the highest  $ZT$  up to 1.56 and a high PF of  $1197 \mu\text{W m}^{-1}\text{K}^{-2}$  at 873 K achieved for the sample with 0.75wt% graphene.

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