Thermal Interface Materials Based on Graphene Networks

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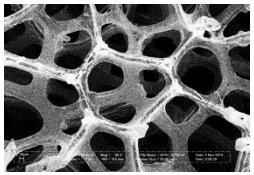
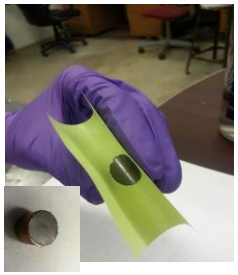
Objective

Develop high-performance thermal interface materials (TIMs) based on thermally interconnected graphene networks and their composites.

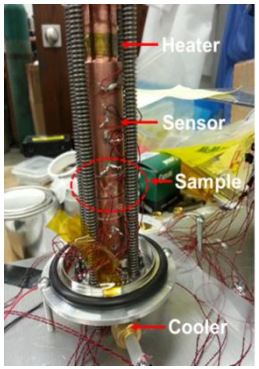


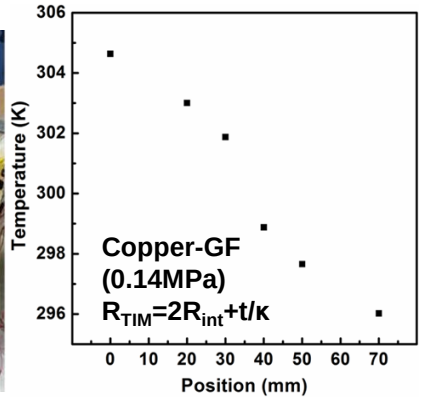


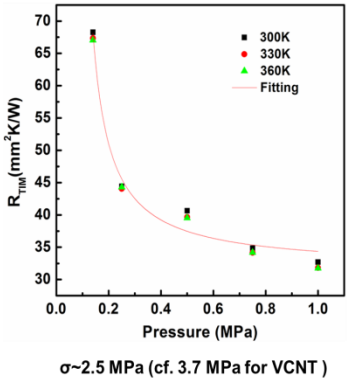
Experiment

Measurement setup

Modified ASTM D5470







σ~2.5 MPa (cf. 3.7 MPa for VCNT)

Wool fiber deformation theory[2]

$$\frac{A(real)}{A(nomi)}(P)=\frac{2}{3}\frac{P}{P+\sigma}\left[\frac{t_0-t'}{(\sqrt[3]{2}-1)\cdot t'+t_0}\right]$$

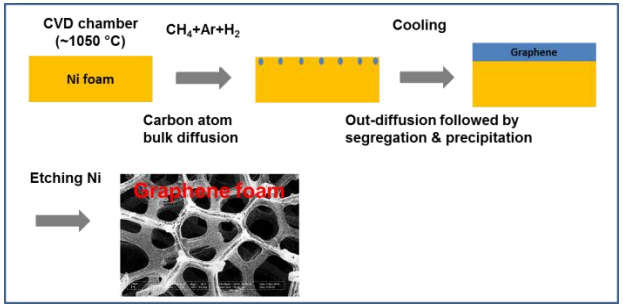
$$R_{TIM}\propto\frac{A(nomi)}{A(real)}\propto 1+\frac{\sigma}{P}$$

A : Area
P : Pressure
σ : parameter related to resistance to compression
t_0: Initial thickness without pressure
t': Incompressible thickness

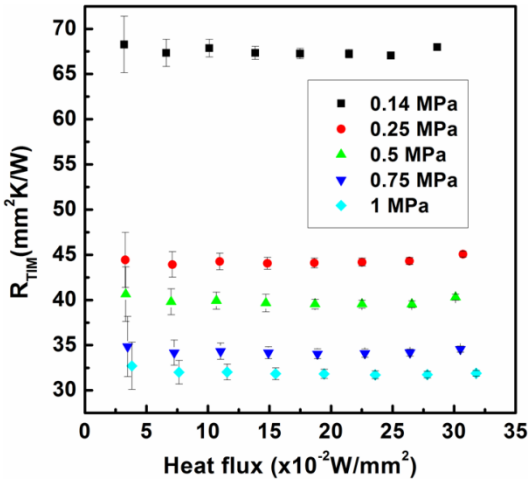
- Thermal resistance (R_{TIM}) between copper and graphene foam (density~6.5 mg/cm^3) is measured to be ~32 mm^{2}K/W at 1MPa.

Approach

Graphene foam (GF) prepared by chemical vapor deposition (CVD) method [1] and GF composites



R_{TIM} between copper and graphene foam



Impact

- GF has relatively high thermal conductivity regardless of the low density.
- GF is ultra-lightweight, flexible, and compressible (more compressible than CNT array).
- GF prepared by CVD can be easily scaled up and it is cost-efficient.

References

[1] Z. Chen *et al.* Nat. Mat. 10, 424 (2011).
[2] X. Zhang *et al.* Carbon 66, 201 (2014).

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