Graphene/Copper nanowire nanocomposite for thermal management application

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Graphene has the highest thermal conductivity of up to 5300 W/m.K among the materials known as far, which is most potential to become the next generation thermal conductive material. In the past, two dimensional macroscopic assembling architecture, the graphene film has been attractive as the effective thermal spreader. However, the graphene film could not meet the demand for high-power-density devices due to limited thermal transportation capability per time unit. Constructing three dimensional graphene architecture (bulk) is a great challenge. Here we propose a novel method to fabricate the three dimensional assembling graphene and copper nanowire nanocomposite, where the thickness direction could be changeable. The introduction of copper nanowire could densify the nanocomposite. The electrical conductivity of graphene-based nanocomposite reaches $8 \times 10^5 s/m$ and the thermal conductivity is up to 1100 W/m.K, which is nearly there times that of copper, six times that of aluminum. The graphene/copper nanowire nanocomposite is very promising in reducing the high-power-density device temperature.

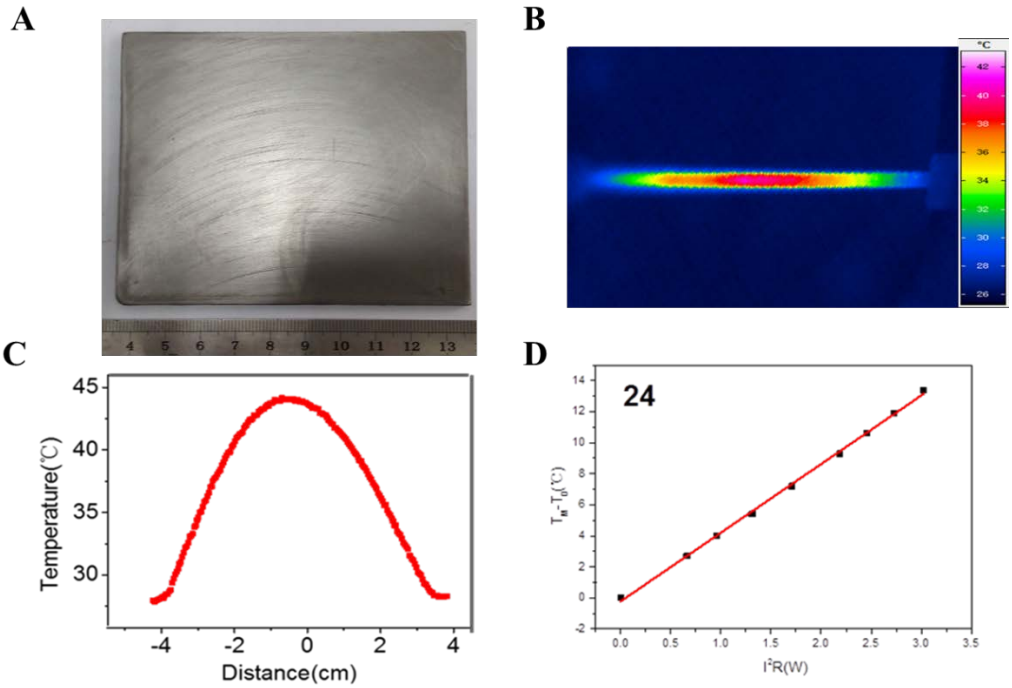

Fig. 1 (A)A photograph of graphene/copper nanowire nanocomposite with 3mm in thickness (B)A false-color thermal infrared image of the self-heated sample. (C) A temperature profile along the fiber from (B). (D) The change of temperature difference

between the middle of the sample and the end of the sample (ambient temperature) with respect to input power.The thermal conductivity reached from(D) is 1100W/(m.K)

References

[1] Xin G, Yao T, Sun H, et al. Highly thermally conductive and mechanically strong graphene fibers[J]. Science, 2015, 349(6252): 1083-1087.

[2] Hsieh C T, Lee C E, Chen Y F, et al. Thermal conductivity from hierarchical heat sinks using carbon nanotubes and graphene nanosheets[J]. Nanoscale, 2015, 7(44): 18663-18670.

[3] Xin G, Sun H, Hu T, et al. Large-Area Freestanding Graphene Paper for Superior Thermal Management[J]. Advanced Materials, 2014, 26(26): 4521-4526.

[4] Kuang Y, Lindsay L, Huang B. Unusual enhancement in intrinsic thermal conductivity of multilayer graphene by tensile strains[J]. Nano letters, 2015, 15(9): 6121-6127.