Graphene films for efficient electronics cooling

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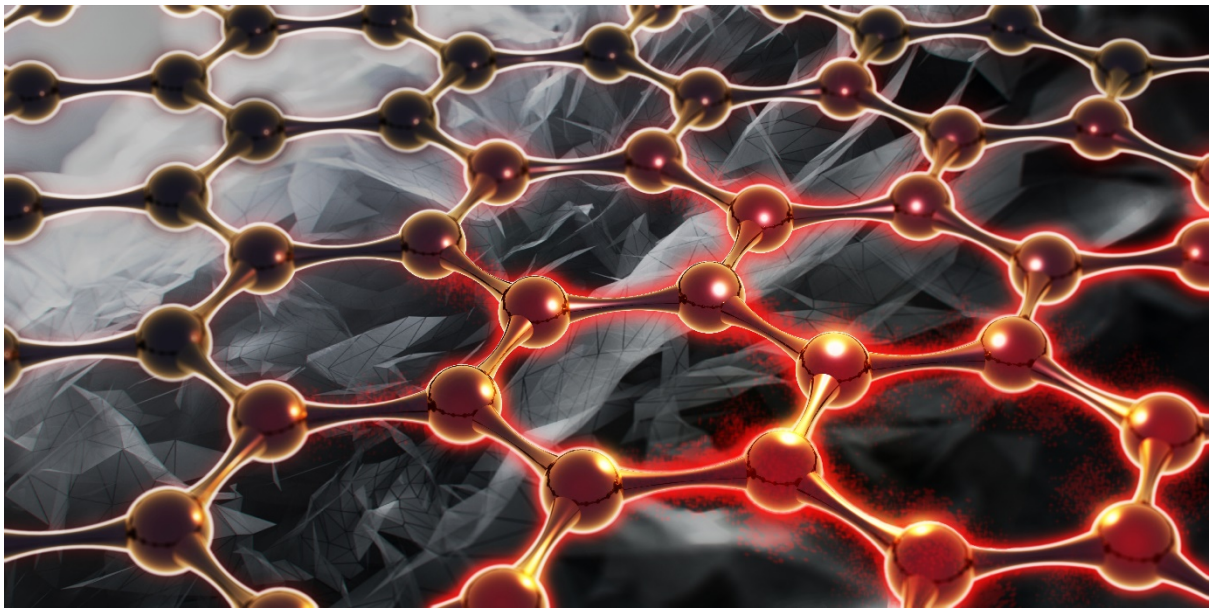

Fig. 1: Graphene films provides efficient cooling of automotive electronics, RF and power modules and LEDs.

What is it? Using graphene assembled films, we have developed a way to efficiently cool automotive electronics, RF and power modules including IGBTs and rectifiers, laser componets and LEDs.

Why does it matter? With the development towards miniaturization, high performance and multi-functionality, critical thermal dissipation issues are threatening performance and reliability of electronics, batteries and many other high power systems due to tremendous heat fluxes generated. For example, the next generation of radio base stations will use 5-6 bit signal processor (DSPs) comprising many tiny processor chips with a size less than 0.25 cm^2 and the power about 5-6 W. Each unit can generate about 30 W heat, which leads to a very high local heat flux up to 400 Wcm^{-2} ;[1] In addition, other high-speed electronics, such as laser products used as the light source in communication devices could generate a high power density about 500-1000 Wcm^{-2} on less than 0.5 mm^{-2} area of the chip. Therefore, how to spread and dissipate the excess heat generated from high power density electronics products in order to maintain a stable performance of devices has become one of the most critical issues.

How does it work? We have done this through careful control of both grain size and the stacking orders of graphene layers. The high thermal conductivity is a result of large grain size, high flatness, and weak interlayer binding energy of the graphene layers. With these important features, phonons, whose movement and vibration determine the thermal performance, can move faster in the graphene layers rather than interact between the layers, thereby leading to higher thermal conductivity.

Publications

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Patent *A method for synthesis of silica coated graphene functional hybrid material*, Patent No: US 10,172,941 B2.

Media coverage

Graphene assembled film shows higher thermal conductivity than graphite film, ScienceDaily, https://www.sciencedaily.com/releases/2018/06/180621101336.htm, June 21, 2018.

Chalmers team demonstrated graphene films with higher thermal conductivity than that of graphite films, https://www.graphene-info.com/chalmers-team-demonstrated-graphene-films-higher-thermal-conductivity-graphite-films, July 1 2018.