Hot carrier-mediated thermoelectric transport in graphene devices

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Abstract

We investigate hot carrier propagation across graphene via an electrical nonlocal injection/detection method. Using two remote leads for electrical heating, we generate a carrier temperature gradient that results in a measurable thermoelectric voltage V_{NL} across the detector leads. At high temperatures, V_{NL} is exclusively due to the Seebeck effect. Interestingly, a departure from the ordinary Joule heating relation, $V_{NL} \sim P$, becomes readily apparent at low temperatures, representing a fingerprint of hot carrier dominated thermoelectricity [1].

By studying V_{NL} on both non-encapsulated graphene devices and fully hBN encapsulated graphene devices as a function of DC bias, gate, temperature and distance, we directly determine the carrier temperature and the characteristic cooling length for hot-carrier propagation, which are key parameters for a variety of new applications that rely on hot-carrier transport. The difference of carrier propagation between the two types of devices will be highlighted.

References

[1] J. F. Sierra, et al. Nano Letters, 15(6), 4000-4005. (2015)