Thermal Transport in Graphene-based Hot Electron Bolometers with Different Electrode Contacts

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We report on the experimental study of thermal transport of hot electrons in graphene-based hot electron bolometers (i.e., graphene microbridges) with different contacts. In the experiment, the temperature of hot electrons in a graphene microbridge is probed based on Johnson noise thermometry. We measured the thermal conductance of two samples at different bath temperatures, one with its electrodes of normal metal Au and the other with superconducting Nb electrodes. We found that thermal coupling through electron diffusion is dominant in the graphene microbridge with Au electrodes at temperatures below 9 K, and the measured thermal conductance follows the Wiedemann-Franz law, i.e., with linear temperature dependence. The unexpected thermal coupling through electron diffusion limits the sensitivity of graphene-based hot electron bolometers [1]. Hence we adopted superconducting Nb electrodes to prevent out-diffusion of hot electrons. It has been found that with the aid of superconducting electrodes, hot electron energy can be well confined within the microbridge, and the thermal conductance is reduced by nearly two orders at 0.3 K.

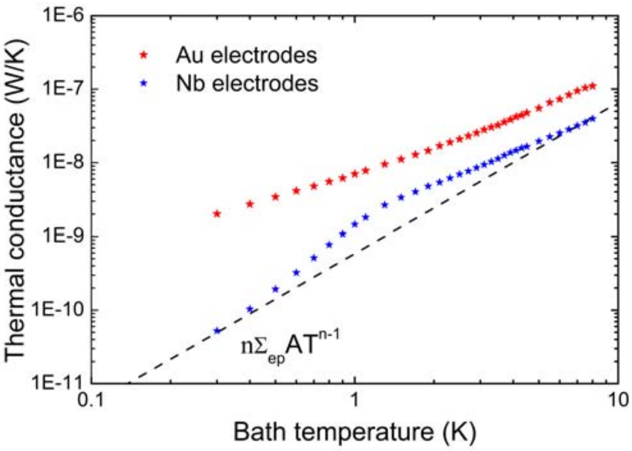

Fig. 1. Measured thermal conductance of the graphene-based hot electron bolometers with Au contacts and with Nb contacts at different bath temperatures.

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References

[1] W. Miao, H. Gao, Z. Wang, W. Zhang, Y. Ren, K.M. Zhou, S.C. Shi, C. Yu, Z.Z. He, Q.B. Liu, and Z.H. Feng, "A Graphene-Based Terahertz Hot Electron Bolometer with Johnson Noise Readout," *J. Low Temp. Phys.*, vol. 193, no. 3-4, pp.387 –392, Nov. 2018.

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