# Supporting Information

## Hot carriers in CVD-grown graphene device with a top h-BN layer

C. Chuang[1,2], M. Mineharu[1], N. Matsumoto[1], M. Matsunaga[1], C.-W. Liu[3], B.-Y. Wu[3], G.-H. Kim[4], L.-H. Lin[5], Y. Ochiai[1], K. Watanabe[6], T. Taniguchi[6], C.-T. Liang[3*] and N. Aoki[1*]

[1] *Graduate School of Engineering, Chiba University, Chiba, Japan*
[2] *Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei 10617, Taiwan*
[3] *Graduate Institute of Applied Physics, National Taiwan University, Taipei, Taiwan*
[4] *School of Electronic & Electrical Engineering, Sungkyunkwan University, Korea*
[5] *Department of Electrophysics, National Chiayi University, Chiayi, Taiwan*
[6] *Advanced Materials Laboratory, National Institute for Materials Science, 1-1 Namki, Tukuba, 305-0044, Japan*

E-mail: ctliang@phys.ntu.edu.tw and n-aoki@faculty.chiba-u.jp

## • Conductance-Fluctuation Thermometry

We discuss the method by which we utilize the conductance fluctuations as a self-thermometry.[S1-S2] The important concept of this method is illustrated in Fig. S1 (a) and (b). We show the root-mean-square conductance fluctuations ($\delta g_{\mathrm{rms}}$ with units of $e^2/h$) from sample A as a function of both lattice temperature ($T_{\mathrm{L}}$) and current ($I$), respectively. In Fig. S1 (a), the current was measured at $I$ = 20 nA and the conductance fluctuations were measured at different $T_{\mathrm{L}}$, while in the Fig. S1 (b) $T_{\mathrm{L}}$ was fixed at 0.32 K and the conductance fluctuations were measured at different $I$ so as to cause a similar curve in $\delta g_{\mathrm{rms}}$. By these two corresponding curves in $\delta g_{\mathrm{rms}}$ ($T_{\mathrm{L}}$) and $\delta g_{\mathrm{rms}}$ ($I$), we are able to determine the $T_{\mathrm{e}}$ from the relation of $T_{\mathrm{L}}$ and $I$ that produce the same $\delta g_{\mathrm{rms}}$ amplitude.

By this method as shown in Fig. S1 (a) and (b), we are able to determine the variation of $T_{\mathrm{e}}(I)$ for different order magnitude of measurement currents. In Fig. S2, we summarize the relation for $T_{\mathrm{e}}$ $(I)$ and different order magnitude of measurement currents for all two of the samples discussed in this study.

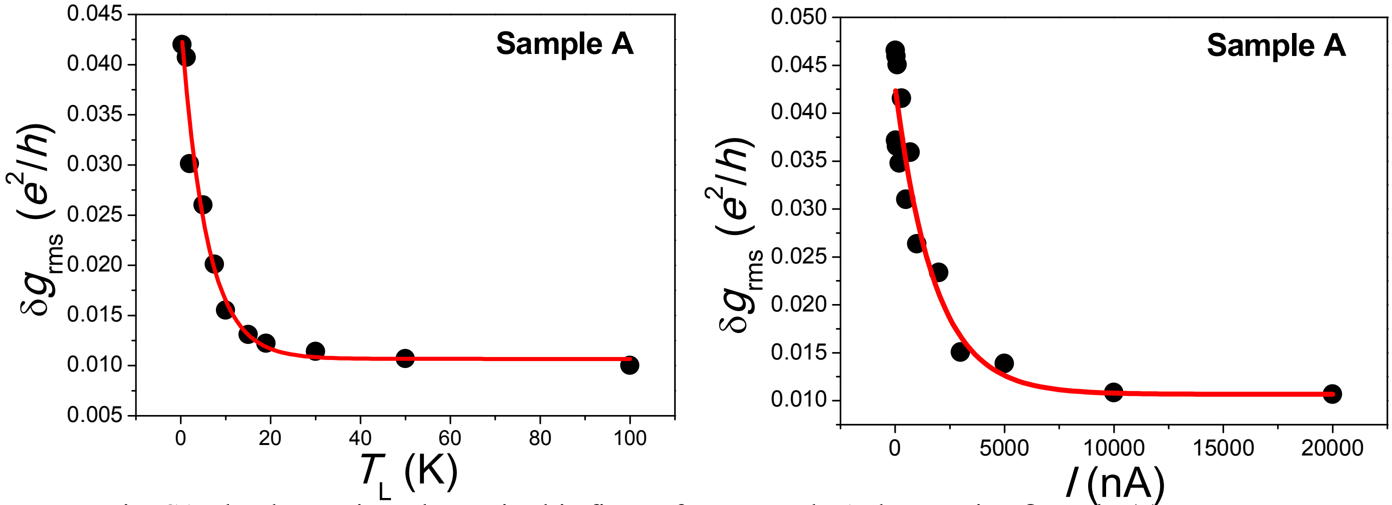


Fig. S1 The data points shown in this figure from sample A, by varying $\delta g_{\mathrm{rms}}$ in (a) $T_{\mathrm{L}}$ and (b) $I$.

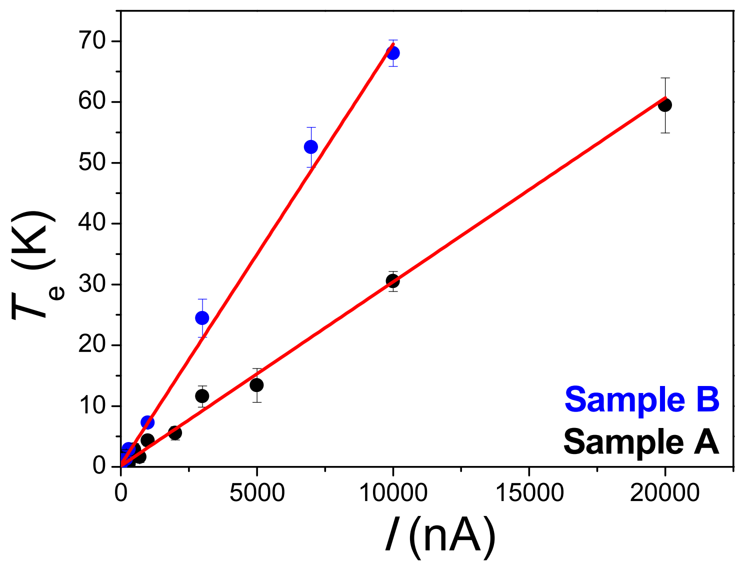


Fig. S2 Summarization of variation of $T_{\mathrm{e}}$ ($I$) established for all two samples using the method of Fig. S1. The carrier density for these two samples are $n$-type and so they are far from the Dirac point ($n \sim 10^{12}$ to $10^{13}$ cm$^{-2}$).

## Supporting Information References

1. R. Somphonsane, H. Ramamoorthy, G. Bohra, G. He, D. K. Ferry, Y. Ochiai, N. Aoki and J. P. Bird, Nano Lett. **13**, 4305 (2013).
2. J. J. Lin and J. P. Bird, Journal of Physics: Condensed Matter **14**, R501 (2002).