Time-resolved Plasmons and Magneto-plasmons in Epitaxial Graphene

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We present a magneto-optical and time-resolved terahertz spectroscopy study of plasmons in as-grown graphene[1] and lithographically defined nanoribbons. We compare magneto-plasmons in regular oxygen-etched, gold-protected, and gold-defined ribbons[2]. We experimentally show a discrepancy with theoretically predicted plasmon resonances. We explain the experimental observation within a core-shell model. The model considers a realistic lateral distribution of dielectric surroundings of graphene flakes and nanoribbons. A weak polarization dependence and high structural anisotropy of SiC substrate exclude the role of SiC step bunching as a primary source of translational symmetry breaking. We also show the temporal evolution of plasmon decay. The plasmon decay results in the formation of hot carriers, and we describe this process by a simple model allowing us to determine hot carriers' temperature and time evolution of energy dissipation.

References

[1] V. C. Paingad et al., Ultrafast Plasmon Thermalization in Epitaxial Graphene Probed by Time-Resolved THz Spectroscopy, Advanced Functional Materials 31, 2105763 (2021)
[2] M. M. Jadidi et al., Tunable Terahertz Hybrid Metal-Graphene Plasmons, Nano Letters 15, 7099 (2015).

Figures

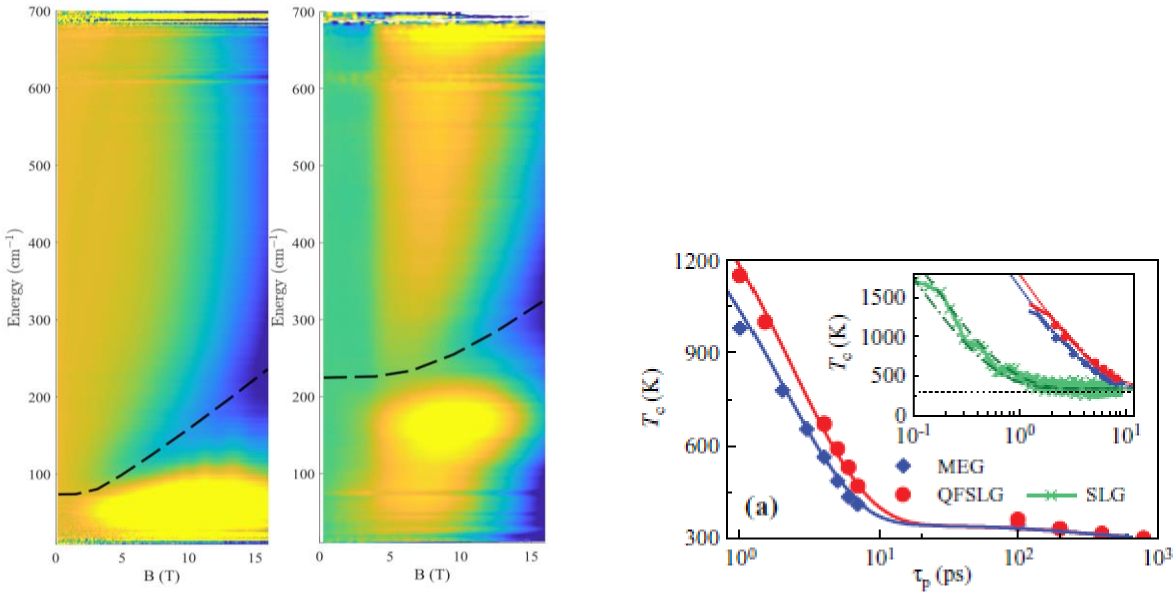

Figure 1: Magneto-plasmons in (left) 3000 nm and (middle) 350 nm wide graphene nanoribbons. (right) Temporal evolution of hot carriers' temperature caused by energy dissipation of decaying plasmon excitations[1].