

Title of the Presentation: Self-energy dynamics and mode-specific phonon threshold effect in a Kekulé-ordered graphene

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Short Biography:

Hongyun Zhang received her Ph. D. in physics from Tsinghua University in 2021. She is currently a Shuimu Tsinghua Scholar working with Shuyun Zhou group at Tsinghua University. Her research focuses on the electronic structure engineering and ultrafast dynamics of two-dimensional materials and heterostructures using angle-resolved photoemission spectroscopy (ARPES) and time- and angle-resolved photoemission spectroscopy (TrARPES).

Abstract:

Electron-phonon coupling (EPC) and related self-energy effects are not only fundamental in determining the equilibrium physical properties of solids, but also critical in determining the non-equilibrium electron relaxation process. Graphene with low-energy excitations resembling relativistic Dirac fermions and strong EPC is an ideal system for investigating the EPC related physics. While the effect of EPC in renormalizing the electronic structure of graphene has been revealed, its role in the non-equilibrium dynamics, especially whether the relaxation is contributed by all phonons or dominated by specific phonon modes is still unclear. In this talk, I will introduce our recent work about the dominant role of mode-specific phonons in the electron relaxation dynamics in a Kekulé-ordered graphene by performing TrARPES measurements ^[1]. By folding the Dirac cones to the Γ point through Li intercalation ^[2], we have succeeded in resolving the self-energy effects in the time domain, which are induced by coupling of electrons with two specific phonon modes at $\Omega_1 = 177$ meV and $\Omega_2 = 54$ meV (Fig. 1(a)). Moreover, those two phonon modes set energy thresholds for the relaxation dynamics of electrons with different energies, and induce hierarchical relaxation from “ultrafast”, “fast” to “slow” (Fig. 1(b, c)).

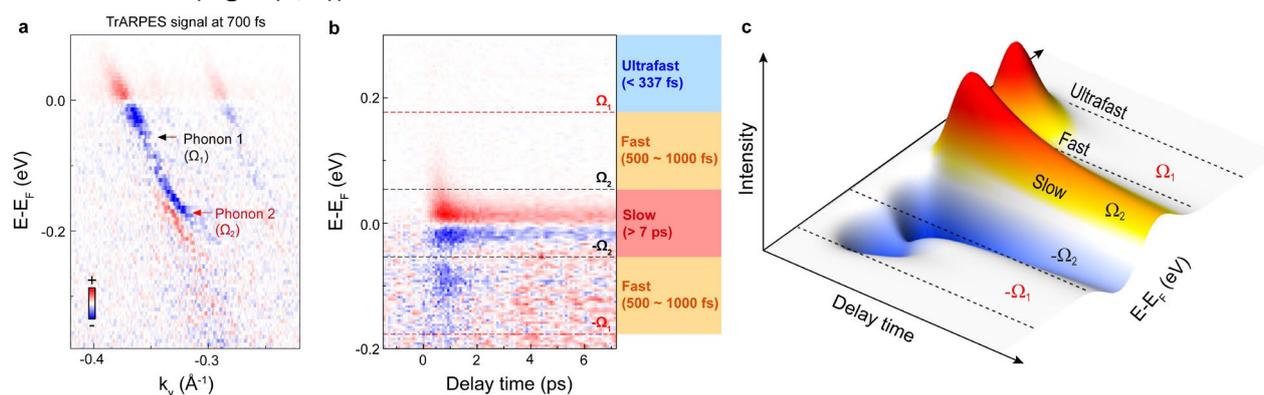


Fig. 1. (a) TrARPES signal measured at 700 fs. (b) TrARPES signal at different delay times and (c) the schematic drawing to show the hierarchical relaxation of electrons.

[1] [H. Zhang[†]](#), [C. Bao[†]](#), et al., Self-energy dynamics and mode-specific phonon threshold effect in a Kekulé-ordered graphene. *Natl. Sci. Rev.* (2021) (Online published).

[2] [C. Bao[†]](#), [H. Zhang[†]](#), et al., Experimental Evidence of Chiral Symmetry Breaking in Kekulé-Ordered Graphene. *Phys. Rev. Lett.* 126, 206804 (2021) (Editor's suggestion & Featured in Physics).