

## Gas Adsorption Dynamics in Graphene by Laser THz Emission Spectroscopy

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Graphene and other 2D materials are attractive for nanomaterial-based devices. However, their properties are highly susceptible to adsorbed gas species on the surface, which makes it important to study gas adsorption dynamics in these materials. Here we applied laser THz emission spectroscopy (LTES) to study O<sub>2</sub> adsorption dynamics in graphene deposited on SI-InP. THz emission from SI-InP dramatically changes upon O<sub>2</sub> adsorption because O<sub>2</sub> adsorbates induce local electric dipoles and modify the SI-InP surface depletion layer [1].

Single-layers graphene samples prepared by liquid phase exfoliation (LPE) and chemical vapor deposition (CVD) were deposited on SI-InP substrates. Samples were optically excited using infrared (IR) pulses from a Ti:sapphire laser, and the emitted THz radiation was guided into a dipole-shaped LT-GaAs photoconductive switch by a pair of off-axis parabolic mirrors.

Figure 1 shows the time-domain waveforms of THz emission from (A) LPE graphene/SI-InP and (B) CVD graphene/SI-InP at 2-minute intervals after continuous IR irradiation in vacuum ( $\sim 1.5 \times 10^{-3}$  Pa). The initial waveform for LPE graphene (Fig. 1A) suggests stronger adhesion of O<sub>2</sub> compared to CVD graphene (Fig. 1B). THz measurements taken after breaking the vacuum also suggest a faster adsorption rate for LPE graphene. These observations are most likely attributed to the difference in surface morphologies of the samples. More defects (adsorption sites) are expected for LPE graphene compared to CVD graphene. We also observed a decrease in the adsorption rate for both samples after removal of moisture on the surface by thermal annealing at 400 K. LTES measurements taken at different pressures and temperatures will also be discussed.

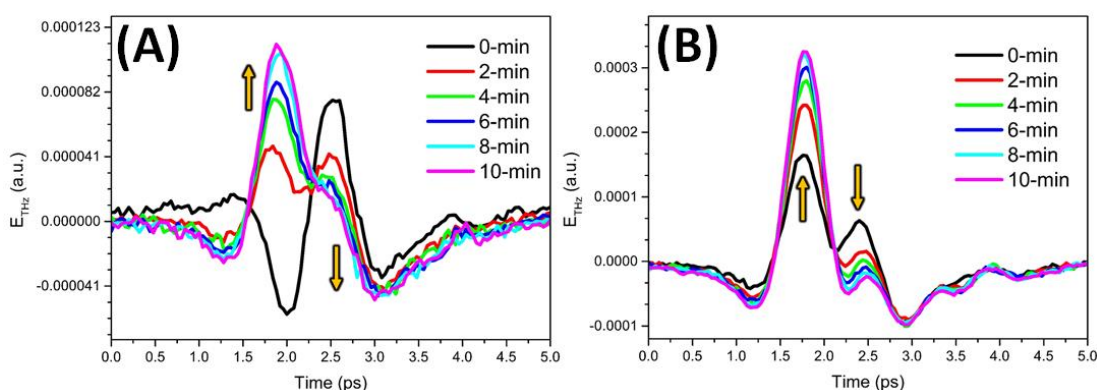


Fig. 1: Evolution of THz emission from (A) LPE graphene/SI-InP and (B) CVD graphene/SI-InP in vacuum ( $\sim 1.5 \times 10^{-3}$  Pa).

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