489. Title:Graphene signal mixer for sensing applications
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Abstract:A multilayer graphene device performing as a chemistry-based signal mixer is shown by a theoretical-experimental approach. We find current fluctuations across a three-layer graphene cluster using a combination of density functional and Greens function theories. We suggest that these current fluctuations are due to the effect of the external bias on plasmons created from electron delocalization in graphene plates. The bias potentials affect the intrinsic behavior of the electron density corresponding to the frontier orbitals and perhaps other energetically near orbitals. The theoretical finding suggests that if the sheets of graphene show a plasmon behavior they may be used to mix signals of different frequencies. We corroborate this suggestion performing a proof-of-concept experiment on a sample of few-layer graphene by introducing two signals of different frequencies. We find experimentally that the recovered output contains the input frequencies, their sum and differences, as well as their second- and third-order harmonics, among others. Thus, plasmons between graphene layers and their high sensitivity surface make the graphene layers a mixer device able to detect the frequency differences of the input signals. Eventually these input signals could come from vibrational modes of molecules, and such a mixer would be of strong importance for sensing science and engineering at terahertz frequencies.