Thermoacoustic generation in graphene field-effect transistors

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Abstract

Graphene is an ideal material for thermoacoustic generation [1,2], where modulated heating of the crystal is converted directly into an acoustic signal in the surrounding media. In a graphene field-effect transistor (FET), this modulation can occur in response to an electrical current driven through the channel and voltage applied to the gate [3]. We show that control of the charge transport in such an FET in air can influence the magnitude, phase and harmonic content of the sound. In particular, we show that the gate voltage can be used to tune this output sound power by over an order of magnitude. This is demonstrated in both bottom- and top-gated devices for a wide range of device geometries and experimental conditions.

Previously, thermoacoustic generation from thin conductive films has been considered to be a highly inefficient mechanism [4] and, as a result, of limited interest for practical devices. We show that for graphene FETs this efficiency can be enhanced. Moreover, the sound generation can be used to directly probe the electrical and thermal properties of the graphene itself.

References

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