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A Single-Molecule Phonon Field-Effect Transistor MARCOS MENEZES, Universidade Federal do Rio de Janeiro, Brazil, BRENDA MOREIRA, Universidade Federal do Pará, Brazil, JORDAN DEL NERO, Universidade Federal do Pará and Universidade Federal do Rio de Janeiro, Brazil, RODRIGO CAPAZ, Universidade Federal do Rio de Janeiro, Brazil — Controlling phonons in the same way we control electrons in materials has been an old but elusive dream for physicists. In particular, it would be extremely desirable to control the thermal (phonon) flux between two reservoirs using a gate electric field, i.e., to construct a field-effect transistor for phonons. However, in most materials, electric fields do not couple strongly to lattice vibrations. Moreover, at the molecular and nano scale, in which the ballistic regime is dominant, thermal conductance of acoustic modes is universal, independent of the sound velocity. Therefore, modulating the sound velocity does not change the thermal conductance, thus making even more difficult the conception of such device. In this work, we propose a realizable architecture for a phonon field-effect transistor based on a single polar polymeric molecule placed between two reservoirs. An applied transverse electric field transforms the acoustic torsion mode into optical. For feasible temperatures and electric field magnitudes, this coupling can virtually suppress the contribution from this mode to the thermal conductance, therefore modulating the conductance by as much as 25%.

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