Thermoelectric properties of graphene nanorings

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Abstract

Nanostructured materials have proven to be very promising to achieve high thermoelectric figure of merit [1,2]. The enhancement of the figure of merit in these systems can be caused by different mechanisms. In particular, quantum effects were predicted to have strong impact on the thermoelectric efficiency [3]. Therefore, graphene is an ideal material for designing nanodevices with enhanced figure of merit due to its long electron coherence length [4].

In this work we consider a square graphene ring connected symmetrically or asymmetrically to two leads. The electron flow through the device is controlled by a side-gate voltage [5,6]. The transmission coefficient of the non-gated ring manifests Breit-Wigner resonances or Fano anti-resonances, depending on the connection geometry and the width of nanoribbons forming the ring. While Breit-Wigner resonances lead to a moderate thermoelectric response, the occurrence of Fano anti-resonances causes a dramatic enhancement of the figure of merit. However, even if a ring does not support Fano anti-resonances, the application of a side-gate voltage can induced such features in the transmission spectrum which, consequently, leads to an enhanced thermoelectric response. This paves the way to use the proposed device as a tunable thermoelectric generator.

References

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Figures

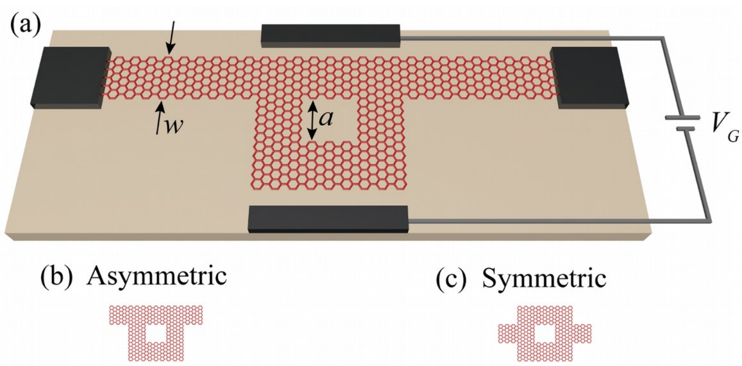

Figure 1. (a) Schematic view of the graphene nanoring. A side-gate voltage can be applied across the ring to control the electron flow. The connection can be (b) asymmetric or (c) symmetric.