High thermoelectric figure of merit in graphene nanorings

M. Saiz-Bretín, A. V. Malyshev, and F. Domínguez-Adame

Departamento de Física de Materiales, Universidad Complutense, E-28040 Madrid, Spain
marta.saiz.bretin@ucm.es

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 coherence lengths [4].

In this work, we consider a square graphene ring connected symmetrically or asymmetrically to two leads. A side-gate voltage allows us to control the current in the device [5]. 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-resonaces, the application of a side-gate voltage can induced such features in the transmission spectrum which, consequently, leads to an enhancement of the thermoelectric response. This opens a possibility to use the proposed device as a tunable thermoelectric generator.

References

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Figures

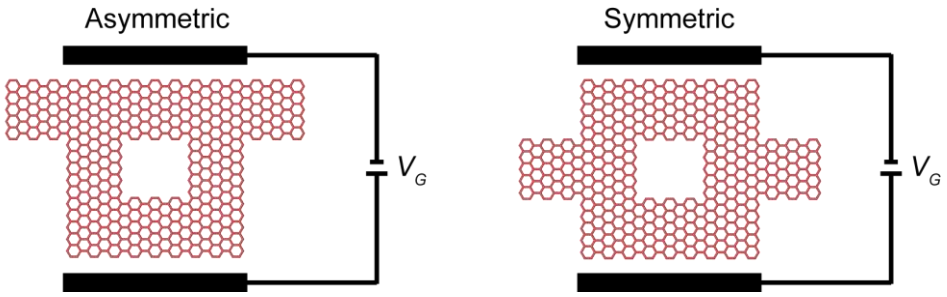

Figure 1. Schematic view of graphene nanorings connected symmetrically or asymmetrically to two armchair nanoribbons. A side-gate voltage, V_G, can be applied across the ring.