Improving the ballistic ac conductivity through quantum resonance in nanowires

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Based on the Kubo-Greenwood formula, a renormalization plus convolution method[1] is developed to investigate the frequency-dependent electrical conductivity of quasiperiodic systems. This method combines the convolution theorem with the real-space renormalization technique, being able to address multidimensional systems with 10^{24} atoms. In this work, an analytical evaluation of the Kubo-Greenwood formula is presented for the ballistic ac conductivity in periodic chains. But for quasiperiodic Fibonacci lattices connected to two semi-infinite periodic leads, the electrical conductivity is calculated by using the renormalization method and the results show that at several frequencies their ac conductivities could be larger than the ballistic ones. This fact might be related to the resonant scattering process in quasiperiodic systems. Moreover, calculations made in segmented Fibonacci nanowires[2] reveal that this improvement to the ballistic ac conductivity via quasiperiodicity is still present in multidimensional systems. Finally, an analysis of these resonant ac transport modes at low temperature is also presented.

1. Sanchez V. and Wang C. (2004) Phys. Rev. B 70, 144207.
2. Wang C., Salazar F. and Sanchez V. (2008) Nano Lett. 8, 4205.

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