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The influence of spin on electronic transport in reduced graphene oxide

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Abstract content
   (Max 300 words)

Electronic transport through impurity clusters embedded in a high potential matrix is of great interest towards the development of spin-polarized and tunnel switching devices based on weakly disordered systems, such as disordered graphene. Through a theoretical study of such systems we have shown that the confinement of two quasi-bound states based on constructive quantum interference phenomena can be tuned through geometrical changes in the system. This model can be applied to reduced graphene oxide (RGO) on the basis of recent studies which have shown that RGO consists of intact graphene nano-islands (impurity clusters) embedded within graphene oxide (high potential regions). Negative differential resistance features are demonstrated which can be tuned through controlling the ratio of the inter-cluster distance to the cluster size. This model is extended to include spin-transport in conjunction with our recent experimental observation of the Kondo effect in RGO. We have demonstrated the influence of spin on electronic transport in RGO through a temperature dependent metal insulator transition in resistance (at ˜ 30 K) as well as high field magneto-resistance (MR) measurements [1]. Analysis of these features in RGO within the Fermi liquid description of the Kondo effect, combined with negative MR which scales with a Kondo characteristic temperature, establishes the interaction between conduction electrons propagating through intact graphene nano-islands and localized magnetic moments found in disordered regions [2]. This study will illuminate the interplay between constructive interference phenomena arising due to the distribution of impurity clusters and the Kondo effect, reliant upon the coupling between localized magnetic moments and itinerant charge carriers.

[1] R. McIntosh and S. Bhattacharyya, Phys. Status Solidi, 6, 56 (2012).
[2] R. McIntosh, M. A. Mamo, B. Jamieson, S.Roy and S. Bhattacharyya, Europhys. Lett. 97, 38001 (2012).

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