Carbon Nanostructures as Quantum Units

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Abstract

The application of quantum computation and quantum information processing rely on the long coherence time of the fundamental quantum unit — qubit. It has been experimentally evidenced that the electron spin in graphene nanostructures have very long coherence time [1,2], which makes them promising candidate for quantum technology applications. One particularly interesting carbon nanostructure is the zigzag segment of nanographene lattice. Recently we proved that the localized spin states in zigzag edge of a nanographene molecule exhibit exceptionally long coherence time up to 0.4 ms. It has been reported that the zigzag segments can be used to build topological nontrivial phase [3,4]. We have calculated the topological phase in more general graphene nanoribbons and show that there is a correspondence between the localized zigzag states in small nanographene molecule and long graphene nanoribbons. The topological nontrivial phase can be harnessed to build quantum spin chain or realize Majorana zero modes, making these carbon nanostructures open to wider applications.

Figures

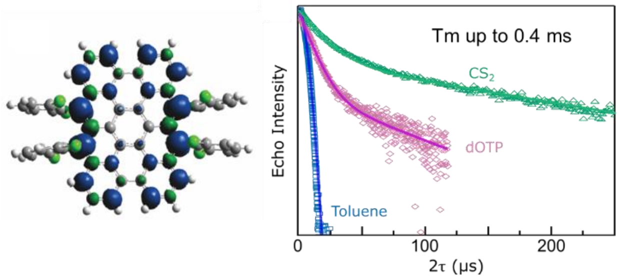

Figure 1: Left panel: The nanographene molecule and the electron spin density. Right panel: the echo intensity decay in Hahn echo measurement in different solutions.[5]

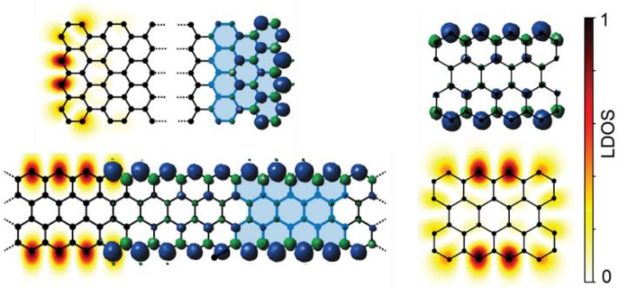

Figure 2: Localized zigzag states in nanographene molecule (right) and long graphene nanoribbons (left).[5]

References

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