Engineered path towards superconductivity through magnetic exchange in transition-metal intercalated bilayer graphene

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INTRO:

This study examines the electronic and magnetic properties of transition-metal intercalated bilayer graphene to help understand the interaction between fermionic and bosonic Dirac modes. From the electronic band structure, we find that the presence of magnetism between the graphene sheets shifts the electronic Dirac cone below the Fermi energy in the antiferromagnetic cases. However, the presence of ferromagnetism disrupts the electronic Dirac nature. Furthermore, it shown that the shifting of electronic bands provides the potential for engineering superconductivity in graphene bilayers.

METHODS:

The *ab-initio* calculations are performed based on the density functional theory by using the atomistic orbital approach implemented in Atomistix Toolkit. Calculations are carried out within the spin-polarized generalized gradient approximation to the exchange-correlation functional (SGGA).

CONCLUSIONS:

The purpose of this study was to examine the effect of intercalated transition-metal elements in bilayer graphene on the electronic and magnetic properties. By using honeycomb lattices, we can further investigate the possible interaction between Dirac Fermions and Bosons. However, we find that most of the transition-metal systems produce an Antiferromagnetic state, which destroys the Bosonic symmetries. However, we do find that the intercalation of transition-metal elements leads to an electronic structure that is similar to other non-magnetic systems that have displayed superconductivity. Therefore, experimental realizations of these materials may lead to the discovery of exotic superconductivity in graphene bilayers.

Possible Superconductivity in Bilayer Graphene with Intercalated Transition-Metal Atoms

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