π-Magnetism inf Engineered Graphene Nanostructures

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Graphene can spontaneously develop intrinsic paramagnetism. Some examples are the emergence of spin-polarized bands in zig-zag edges in graphene, or the observation of magnetic moments in open shell graphene nanostructures. Radical states at the conjugated lattice, as singly occupied states, respond to the presence of finite electron correlations by localizing in certain sites and gaining a net spin polarization. The interesting aspects of this unconventional form of (para)magnetism is that it is part of the conjugated lattice of graphene. Therefore, it extends for nanometers length scales, and interact with others with exchange coupling strengths of tens of millielectronvolts. The challenge of fabricating atomically precise graphene structures with custom shapes for localizing spins and tuning their interactons became possible with the development of on-surface synthesis.
In this presentation, I will show results on spin-hosting nanographenes, including their syntesis routes, their magnetic fingerprints and the origin of such unconventional form of magnetism. We use scanning tunneling microscopy and spectroscopy to detect and spatially localized the spin density by mapping the amplitude of a Kondo resonance [2,3,4,6] or spin excitations [2,5].
One of the most paradigmatic systems for graphene magnetism is Triangulene. These triangular pieces of graphene with zigzag edges exhibit high spin due to frustration of their conjugated lattice [4]. Doping the triangulene with heteroatoms can modify the spin state [6]. However, as we shall show, the charge balance of graphene nanostructures with metallic substrates can also modify their spin state due to new orbital filling configurations. Traingulene can also be connected by covalent bonds and their intrinsic spin state survives. In particular, we found that a Triangulene hexamer ring (see the figure), fabricated by combining solution and on-surface syntesis, exhibits fingerprints collective spin states [4]..

References

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Figures