Materials Science Webinar
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Graphene 2.0: mesoscale ordered 2D π-conjugated polymers with Dirac cones and semiconducting properties

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The isolation of graphene and the demonstration of its remarkable charge-transport properties, due to ultrahigh carrier mobility coming from the Dirac cones in its band structure, have made two-dimensional (2D) materials a major trending topic in materials science and nanotechnology. Dirac cones are not exclusive to graphene but require specific symmetry and delocalized electrons. Efforts have been devoted to identifying 2D materials beyond graphene that offer a greater degree of tunability and a non-zero band gap while retaining high carrier mobility [1].

In this respect, surface-confined polymerization, a bottom-up strategy to create 2D π-conjugated polymers, represents an opportunity to manipulated the electronic band structure of the material by varying the molecular building blocks (e.g. changing symmetry and constituent atoms). Recently, the electronic structures of 2D π-conjugated polymers arranged in a kagome lattice have been theoretical predicted to exhibit both Dirac cones and flat bands [2].

On this talk I will report on the synthesis of mesoscale ordered 2D π-conjugated polymers on Au(111) with semiconducting properties arranged in a kagome lattice showing Dirac cone structures and flat bands [3, 4]. These results overcome the major barriers to the application of 2D π-conjugated polymers due the small domain size and high defect density attained so far. Importantly, although the 2D polymers have been obtained on a metal surface, they can be detached and transferred to other more applicative substrates to be used in electronic devices. I will also report on the studies concerning the formation of 1D and 2D polymers by on surface-synthesis performed at the Istituto di Struttura della Materia (CNR) by the help of Students and Professors of the Physics Department of Tor Vergata University in collaboration with several groups abroad.

References

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