Magnetic And Conducting Molecular Materials

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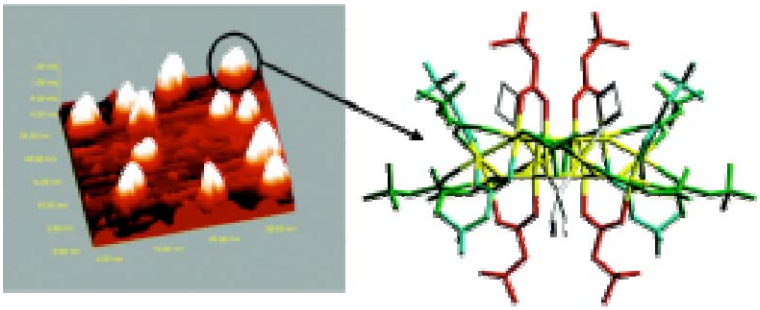
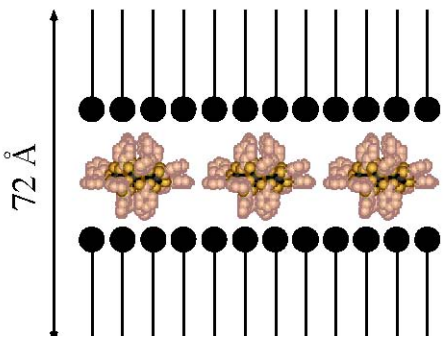
In our Institute we are currently developing different research projects related to molecular electronics from a multidisciplinary perspective. Chemistry, opposite to the more common physical methods of processing of materials, has many potential contributions to make regarding the need of designing, organizing and processing of materials at the nanoscale, since molecules, the smallest chemical building blocks already possess such target sizes, with the remarkable possibility to tune and control chemically the given properties of these bricks.

We are currently developing two main approaches that are, in our opinion, the two most unique and fruitful contributions of magnetic molecular materials to nanotechnology: i) organization of single-molecule magnets at the molecular level; and ii) multifunctional nanostructured materials. In this communication we will give some highlights of the most remarkable results.

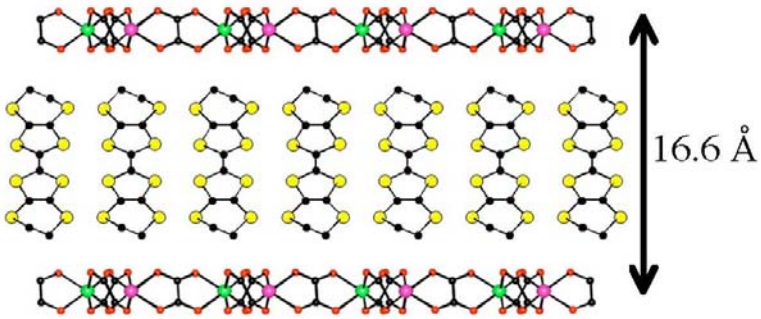
One of the key factors to organize functional molecules in 1, 2 and 3 dimensions is the design of these molecules. This design involves the introduction in the molecule of those groups that can facilitate its anchoring on a solid surface, or that can avoid aggregation, or that can facilitate the self-assembling. We will show here the different chemical approaches we are following to design and organize molecular nanomagnets in 1 and 2 dimensions. That includes: 1) The insertion of molecular nanomagnets in the channels of mesoporous materials;[1] 2) The preparation of thin films, organized as multilayers (using the Langmuir-Blodgett technique),[2] or formed by the molecular nanomagnet embedded in a conducting polymer;[3] 3) The deposition onto gold surfaces;[4] 4) The organization onto silicon or silicon oxide surfaces.





The molecular approach offers many unparalleled possibilities to build multifunctional materials when compared those of solid state chemistry. This subject is only just beginning to move forward and many interesting and challenging combinations of physical properties can be

envisaged. A possible approach consists of building up two-network hybrid solids formed by two molecular fragments where each network furnishes distinct physical properties. If the two networks are quasi-independent a coexistence of the two physical properties is anticipated. If the two molecular networks are coupled a synergy between the properties may be observed. The main results obtained in our labs are: 1) Chemically-built magnetic multilayers in which inorganic ferromagnetic layers alternate with organic layers;[5] 2) Multilayered ferromagnetic conductors in which ferromagnetism coexists with metal conductivity;[6] 3) chiral conductors, in the search for new phenomena;[7] and 4) switchable molecular materials in which a molecular switch can affect the magnetic or electronic properties of the material.[8]



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