2D magnetic molecular materials

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Abstract

Graphene and other 2D materials are almost exclusively based on inorganic lattices. Except for the chemical functionalization of the surface of the 2D material, molecules have been scarcely considered in this area. Here I will illustrate the role of functional molecular materials in this area by selecting some relevant examples:

1) Molecular 2D magnets. I will focus on the design of molecular 2D magnets that, in contrast to what happens with the inorganic 2D magnets, are chemically stable in open air, keeping their magnetic properties preserved upon functionalizing their surface with different organic molecules [1].

2) Smart molecular/2D heterostructures. I propose to create hybrid heterostructures by interfacing stimuli-responsive molecular systems with graphene and semiconducting transition metal dichalcogenides (MoS_2 and WSe_2). The aim is that of tuning the properties of the "all surface" 2D material *via* an active control of the hybrid interface. This concept will provide an entire new class of smart molecular/2D heterostructures, which may be at the origin of a novel generation of hybrid materials and devices of direct application in highly topical fields like electronics, spintronics and straintronics. As smart-molecular systems I will choose magnetic spin-crossover materials able to switch between two spin states upon the application of an external stimulus (temperature, light or pressure) [2]. This spin transition is always accompanied by a significant change of volume in the material (by ca. 10%), so it can generate strain in its surrounding. I will show that in these heterostructures the electronic properties of graphene and the optical photoluminescence of monolayers of semiconducting metal dichalcogenides can be switched by light or by varying the temperature due to the strain concomitant to the spin transition [3,4]

References

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