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Foreword / *Avant-propos*

Foreword: Recent advances in 2D materials Physics

Avant-propos : Physique des matériaux bidimensionnels

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Two-dimensional (2D) materials are fascinating objects for researchers with a wide variety of possible applications. The 2010 Nobel Prize in Physics for graphene is certainly a very famous milestone in their still young history, and the field keeps on renewing itself, at a pace that gives no sign of slowing down, on the contrary.

Altogether, 2D materials host a plethora of intriguing effects and as such, have become playgrounds for revisiting almost every branch or aspect of condensed matter physics, from spin phenomena, superconductivity, photonics, to quantum coherence, electron correlation and many-body effets, topology, and many more.

These materials can be isolated from naturally occurring bulk layered compounds or synthesised from the bottom up, starting from atomic or molecular building-blocks. Quite remarkably, they can be stacked on top of the other to form artificial materials at will, so-called van der Waals heterostructures. Controlling their stacking sequence, one can engineer complex designer materials with e.g. strong electronic interactions and enhanced quantum effects.

The purpose of this special issue of *Comptes Rendus Physique* is to illustrate the latest advances in this field of condensed matter physics, that is currently in full effervescence. Thousands of scientific contributions are published every year in the condensed-matter physics branch focusing on the investigation of these 2D materials, and several valuable topical reviews are published on a yearly basis. Hence there cannot be any pretension for exhaustivity here, and the present introduction will not engage in the delicate endeavour of a general perspective on the physics of 2D materials. This special issue aims to illustrate the richness of these research activities by presenting original results in several sub-fields.

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The field keeps on broadening, touching ever more research topics and involving an ever growing number of scientists and engineers. Basic and applied research based on these materials cross the boundaries of several disciplines, and an overview would obviously be too broad to cover within a collection of articles such as in the present special issue. The special issue focuses on recent advances in basic physics phenomena. These phenomena are inherited from the atomic-scale structural order symmetries in 2D materials, and the resulting unique electronic, optical, magnetic properties. The specific dimensionality of course plays a key role here. Together with the 2D dimensionality, comes the effect of interfaces, which is prominent here, and makes the *van der Waals heterostructures* of stacked 2D materials remarkably fertile fields of research these days.

The articles address various kinds of 2D materials — graphene, superconductors, transition metal (di)chalcogenides, hexagonal boron nitride — and their heterostructures, from experimentalists and theorists viewpoints. The special issue illustrates the variety of effects encountered in these systems, especially: *Electronic effects*, related to defects or in the presence of correlation and topology effects; *Spin-related effects*, in semiconductors and in the presence of the spin-orbit interaction; *Optical effects*, how they relate to the electronic band structure of the materials and with special attention to the physics of excitons influenced by the dimensionality, other excitations, moirés or defects.

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