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EDITORIAL **OPEN**

Your new travel guide to the flatlands

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The last decade has seen a rapid expansion in the research on 2D materials in the form of ultrathin sheets extracted from layered materials. It all started with the isolation of graphene, a single sheet of graphite in 2004. For a while, graphene was the only such 2D material under study due to some of its fantastic properties such as high charge carrier mobility and mechanical strength. Yet graphene did not have a band gap, resulting in graphene transistors that were difficult to turn off and limiting its applications in electronics. The realisation that high-quality electronic devices could be made with MoS_2, a semiconducting 2D material from the transition metal dichalcogenide family opened the field to a wide variety of materials, such as MoS_2, WSe_2, $NbSe_2$ and others rediscovered in the form of 2D sheets. Their wide range of electronic properties, spanning the range from semiconducting to superconducting extended the library of 2D materials further together with other rising stars in the 2D field—phosphorene and silicone being examples.

Behind all the excitement for 2D materials are their potential applications, enabled by a combination of small thickness, usually high mechanical strength, reasonable carrier mobilities and the presence of a direct band gap in most semiconducting 2D materials. Some examples are in electronics and optoelectronics where small thickness and the presence of direct band gap allow the fabrication of low-power transistors, sensitive field-effect transistor-based biosensors and flexible electronic, and optoelectronic devices and systems. These promises have motivated large-scale collaborations in Europe, China, the USA, and other countries.

And yet, we have barely scratched the surface. Just in the family of transition metal dichalcogenides, there are around 40 stable materials. Adding layered oxides, monochalcogenides, trichalcogenides etc. quickly raises this number to several hundred, while theoretical predictions indicate that there could be over a thousand layered materials that could be thinned down to single sheets. Not only single materials are interesting: stacking them in vertical direction in different arrangements results in heterostructures with properties that are not seen in individual components. The sheer number of material combinations is mind-boggling and will keep us busy for decades to come.

Exploring this vast landscape will require an interdisciplinary effort: theoretical modelling to identify interesting materials, and heterostructures and narrow down the choices; synthesis for making new materials a reality, basic research for discovering their intrinsic properties and engineering to turn them into useful concepts. To sustain this research effort over longer time periods and create a virtuous circle of funding, we also need to demonstrate and develop new applications of 2D materials. The initial work in the field was driven by the anticipated breakdown of Moore's law for silicon electronics as the feature size is decreased. Yet, as we learn more and more about the intrinsic properties of 2D materials, we are now starting to explore new possibilities that they enabled such as for example valleytronics or next-generation DNA sequencing.

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In npj 2D Materials and Applications, we aim to publish high-quality original research, perspectives and reviews on 2D materials. We are equally interested in the materials themselves, their intrinsic properties as well as the applications that they enable. This is illustrated by our selection of first papers, which provides a glimpse of this vast and new, rapidly moving field and gives a flavour of what is to come. Tuning of the physical properties of 2D materials with the number of layers is one of their strong suits. Nerl et al.[1] show in their paper how excitons and plasmons can be separately probed, and spatially resolved on few-layer MoS_2 and use this information as a direct fingerprint of the number of layers in the structure. A possible new application for 2D semiconductors is simulated by Qiu et al.,[2] showing that nanopores in 2D materials can be used to detect DNA methylation, a potential biomarker for early cancer detection. Wan et al.[3] present a new possible application for graphene in photodetectors for UV light while Akhtar et al.[4] review recent advances related to phosphorene.

I invite all my colleagues working on 2D materials to submit their most important results and reviews to our new journal. Our editorial team is composed of researchers active in the field, with a diverse and deep portfolio of expertise, and we are all committed to the future of this journal and the field it represents.

COMPETING INTERESTS

The authors declare no conflict of interest.

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