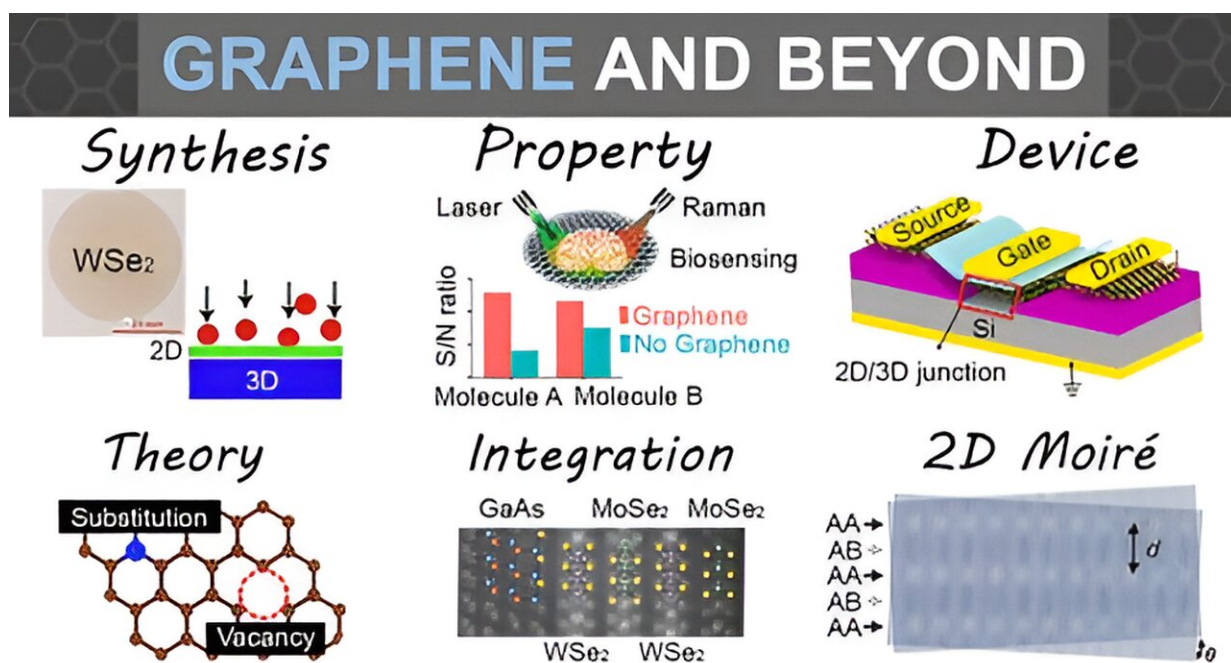# Insights into 2D materials from international collaboration

October 17 2023, by Eimear Bruen

Graphical abstract. Credit: *ACS Nano* (2023). DOI: 10.1021/acsnano.2c12759

Roman Engel-Herbert, Director of PDI, and Joao Marcelo J. Lopes, a Senior Scientist at PDI, were honored recently with an invitation to review the field of two-dimensional layered materials (2DLM) in a paper for *ACS Nano* titled "Recent Advances in 2D Material Theory, Synthesis, Properties, and Applications." PDI's authors drew from their expertise in the field of 2D magnetic materials and heterostructures to

provide insights on the current state and future prospects of the field regarding the synthesis of these materials.

The paper drew inspiration from the 9th Annual Graphene and Beyond workshop held at the Pennsylvania State University in 2022 and included PDI's recent work on scalable growth of high-quality magnetic heterostructures using epitaxial methods. The review encompasses a wide range of topics, including theory, synthesis and processing, material properties, material integration, device study, and twisted 2D heterostructures.

The review sheds light on fundamental topics in the field of 2DLM, including:

- Modeling of defects and intercalants, with a focus on formation pathways and strategic functionalities
- Machine learning for synthesis and sensing
- Important developments in the synthesis, processing, and characterization of various 2D materials
- Optical and phonon properties of 2D materials controlled by material inhomogeneity, multidimensional imaging, biosensing and machine learning analysis
- Mix-dimensional heterostructures using 2D building blocks for next-generation logic/memory devices
- Twist-Angle Homojunctions and their role in quantum transport—Future perspectives for 2DLM

Contributing authors included experts from US institutes such as the Pennsylvania State University, Massachusetts Institute of Technology, Brown University, Rice University, Princeton University, University of Notre Dame, and the National Institute of Standards and Technology. PDI and the University of Innsbruck contributed from the international community.

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