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Highlights in physics of two-dimensional crystals through cryomagnetic optics

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The discovery of graphene –the archetype two-dimensional (2D) system, stimulated the frantic pace of research in the area of 2D materials (2DM). The rapid progress of the field, particularly in the growth technologies, is enabling expanding the research interests in other 2DM with outstanding optical, transport, magnetic and other properties giving rise to a plethora of tailored functionalities. Looking beyond the flatland, the 2D slabs can also be reassembled into designer heterostructures made layer by layer in a precisely chosen sequence. Such heterostructures (often referred to as 'van der Waals') reveal unusual properties driven by the stacking and mutual orientation of the 2D building blocks. In my talk, I will review the current state of knowledge on the most topical areas of 2DM research. First, the stacking phenomenon responsible for numerous exotic states ranging from superconductivity to Mott metal-insulator transition will be discussed. Next, the phenomenon of 2D magnetism will be revisited and I will review the limits imposed on boosting the material's properties given by the Mermin–Wagner theorem. Finally, several recent experimental reports will be highlighted and future prospects in the field of 2DM will be outlined.

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