[Preface]

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The Blossoming of 2D Materials

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The vehement explosion in two-dimensional (2D) materials has led to one exciting new discoveries after another for the past 15 years. This circumstance resembles a famous movie “*The Gold Rush*” (1925) expressed the true story about the stream of American people as crowded as the hurricane to join the gold racing in the 19th century. Similarly, the family of 2D materials has gained tremendous interest from broad scientific community in various fields, from fundamental chemistry and physics to materials and device engineering. This special issue includes both tutorial reviews and original research articles, providing general overviews of the recent progresses and bringing about the newest discoveries in this rapidly evolving field.

Controllable synthesis of 2D materials is foundational for realizing the extraordinary promises of 2D materials. The controllable, reproducible and scalable production of 2D materials represents a standing challenge of the field. The special issue dedicates a considerable fraction of spaces in the synthesis of various 2D materials. In a tutorial review, Liu *et al.*¹ discussed the solution phase synthesis and processing of various 2D materials, heterostructures for the mass production of a variety of chemical functional-based heterostructures. In an original communication, Wu *et al.*² reported a liquid-phase approach to antimonene quantum dots for applications in optical devices, molecular adsorption, and thermoelectric devices. Wang *et al.*³ reported a new synthesis method to three-dimensional (3D) graphene *via* biomass hydroxyapatite, offering a potential pathway to low-cost and mass production of 3D graphene for industrial applications. In addition, Chen *et al.*⁴ used the Kinetic Monte Carlo simulation to investigate the chemical vapor deposition (CVD) growth of MoS₂, and found that the growth rate of second-layer is strongly depended on the first layer.

Defects play a critical role in determining the chemical, physical and electronic properties of 2D materials. Liu *et al.*⁵ reported a density functional theory (DFT) study to probe the role of point defects in modifying the electrical conductivity of graphene. They revealed breaking graphene honeycomb lattice by point defects lead to the localized states near the Fermi level to profoundly modify their electronic properties. Xiong *et al.*⁶

used molecular dynamics (MD) simulation to investigate the interaction of defective or doped graphene with polymer composite and their impacts on thermal conductivities. Additionally, Liu *et al.*⁷ systematically investigated the phonon vibration mode of single-layer to few layer and the bulk WS₂ as a function of thickness and temperature.

Heterostructures are essential for creating functional devices for diverse applications. Li *et al.*⁸ gave a concise overview on the 2D van der Waals heterostructures and their potential applications for photodetection and other optoelectronic devices. Ren *et al.*⁹ reported the synthesis of Ag/WO_{3-x} heterostructures that may enable rapid separation and transfer of photo generated charge carriers. In a tutorial review, Du *et al.*¹⁰ provided an overview of heterostructures formed between 2D materials and biomacromolecules, and showed specifically designed 2D material biomacromolecule heterostructures could lead to tailored electrical, mechanical, and biological characteristics. In another tutorial review, Cheng *et al.*¹¹ discussed the potential in exploring nanoporous 2D materials for membrane separations with excellent flexibility, chemical stability, mechanical strength, and the ultimate atomic scale thickness.

Discovering and investigating new 2D materials is indispensable for continued expansion of the 2D material family, enabling improved properties or totally new functions. Zhang *et al.*¹² reports a class of ferroelectric 2D materials (ABP₂X₆) (A: Ag, Cu; B: Bi, In; X: S, Se) with unique negative Poisson's ratio, which may offer significant potential for the next-generation memory devices or nanoelectromechanical devices.

Together, we thank all the authors, referees and the editorial office for their efforts to make this special issue possible. We hope you all will enjoy this outstanding collection of research articles and tutorial reviews on the 2D blossoming.

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