EDITORIAL

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Preface to the Special Issue on 2D-Materials-Related Physical Properties and Optoelectronic Devices

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Recent advances in two-dimensional (2D) materials following the successful fabrication of graphene in 2004 by Novoselov and Geim is expected to grow into the new silicon, offering a lifeline for Moore's law. With the rapid development of the synthesis methods, more and more 2D materials, such as transition metal dichalcogenides (TMDs, MX_2), black phosphorus (BP) and InSe with a finite gap are reported to be more promising for achieving this dream since they often offer alternative solutions to compensate for the gapless graphene's weaknesses. 2D materials are single or few-layer thick, in which the atoms in a single layer connect with the strong covalent bonds while the adjacent layers are bonded via weak van der Waals (vdW) interactions. The ultrathin thickness and high mobility of 2D materials have opened new pathways for materials with just one-atom thickness to be used in the post-silicon electronic era. Furthermore, the electrons in 2D materials are almost confined in a 2D plane, leading to massless carriers, strong excitonic effects and valley polarization. In addition, some 2D materials, such as BP and $ReS(Se)_2$, exhibit strong in-plane anisotropy, offering a new degree of freedom to deliver various physical properties compared with the isotropic 2D materials. Any two or more 2D materials with similar properties can be alloyed into a new layered material, namely, 2D alloy. More interestingly, the combination of these emergent 2D materials with rich properties paves way for fabricating vdW heterostructures. The electronic and optoelectronic performances in the vdW heterostructures can be enhanced and tuned by applying gate voltages, which may provide a fundamental platform to realize novel physical phenomena and device applications. Although many scientists are still devoted to finding the superior 2D semiconductors for nanoelectronic industry, we believe that they can find their place in the post-silicon electronics based on the great achievements made.

This special issue contains 6 original articles with both experimental and theoretical investigations, such as the new results on substrates and interlayer coupling effects on $Mo_{1-x}W_xSe_2$ alloys, growth of oxidation-resistive silicene-like thin flakes and Si nanostructures on graphene, electronic band structures and optical properties of atomically thin AuSe, and bilayer tellurene–metal interfaces. This special issue also contains 3 review articles on emergent 2D materials (including anisotropic materials, atomically thin α-In_2Se_3, and large-scale 2D materials by polymer-assisted deposition). The issue attempts to provide a latest overview of the rapidly developing research area of 2D materials.

We sincerely hope that this issue on 2D materials can benefit researchers on this topic. We would like to thank all the authors who have contributed high-quality peer-reviewed articles to this special issue. We are also grateful to the editorial and production staff of *Journal of Semiconductors* and Prof. Zhongming Wei for their superb assistance.

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