Graphene and atom-thick 2D materials: Device application prospects

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The electronic properties of low-dimensional systems have long been an interesting topic in both physics and engineering societies. Silicon MOSFET and III-V HEMT devices, for example, not only have been the most essential elements in micro- and nano-electronics since their early days, but have also provided wonderful playgrounds for correlated two-dimensional (2D) electron systems leading to the observation of integer and fractional quantum Hall effects. These traditional 2D electron systems now reconfigure themselves into atomic sheets, giving rise to entirely new physics originating from the material aspects as well as the dimensionality itself. Such new physics presents us with a reciprocal opportunity of innovating conventional 2D devices, and in this talk, I will discuss these new opportunities and accompanying challenges. Various aspects of potential device applications of graphene and atom-thick 2D materials, including photo-devices, new types of transistors, and integration with CMOS, will be discussed. Direct growth of these atom-thick materials is the key technology to make all these applications realistic, and the prospects for wafer-scale graphene and 2D material growth will also be presented.