New Directions in Materials Science and Technology: Two-Dimensional Crystals

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Smart advanced materials that are flexible (for transparent wearable electronics), adaptable (that change structure depending on exterior conditions), multifunctional (that can be tuned by application of electric and magnetic fields, pressure or strain), and at the same time are environmentally friendly (that do not waste energy and are low power consuming), are the ultimate dream of materials scientists and engineers. Such materials hold the key to the next generation of devices with deep incursions into new markets. The discovery of graphene and other two-dimensional crystals in 2004 has finally brought materials with the promise of such properties to light. More importantly, the recent breakthrough in their industrial scale fabrication is paving the way towards a new era in materials science and technology. A shift in such a key economic sector will provide unprecedented opportunities in transforming the industry with impact in several fundamental areas: energy, defense, communications, electronics, artificial intelligence, and information technology. I will describe the latest developments, the opportunities, and future challenges in this new field and the plans at the Graphene Research Centre at the National University of Singapore to develop and study, theoretically and experimentally, a large family of advance materials, which do not exist in nature (and certainly are not yet available commercially) with new functionalities that can meet the needs of an ever-demanding market.