

An Overall Perspective on 2D Materials

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Graphene goes back a long way, to 1947 (or maybe earlier). It was then that the electronic structure of monolayer graphite was predicted by Wallace in Canada. The high-impact work of Professor Boehm in Germany in 1960, showing the existence of monolayer graphite (graphene) experimentally, moved the nanocarbon field forward at an early time. The development of highly ordered pyrolytic carbon by Professor Ubbelohde at Imperial College in London soon resulted in the commercial production of this product by the Union Carbide company in the U.S. An extensive program of industrial products based on anisotropic layered materials soon emerged. This encouraged my research group to collaborate with Professor Ali Javan at MIT to do optical experiments in a magnetic field which identified the locations of electrons and holes in the Brillouin zone as we know them today. The early studies of graphene intercalation compounds allowed study of monolayer, bilayer, few-layer carbon when these layers were sandwiched between insulating single layers to produce periodic structures in the 1970s, leading to the first international conference on such superlattices of layered periodic nanostructures took place at La Napoule in France in 1977. Fifteen years later, carbon-based layered structures discussions took the form of carbon nanotubes led by the NT conference in Japan and also at the IBM research labs in the 1990s.

Growth of interest in nanoscience materials accelerated at the time following the

announcement of the experimental discovery of monolayer graphene and its exceptional properties by Novoselov and Geim in 2004. From their new discoveries, the remarkable properties of layered nanostructures came to center stage, first with few-layer carbon, and soon followed by the corresponding studies done on transition metal dichalcogenides (TMDs), based on work done in the 1990s on few-layered TMDs. The rapid and extensive developments of nanoscience have continued at a rapid pace through the second decade of the 21st century. Thus the year 2017 seems like an appropriate time to start thinking seriously about the future of layered nanostructures in the third decade of this century.