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Substrates rubbing method for obtaining mono- and few layer graphene and 2D materials

An extremely simple, fast, cost-effective, transfer- and chemical-free, reliable and industrially scalable non-conventional rubbing method (substrates rubbing method) for obtaining high quality and large size mono- and few layer (MFL) graphene, hexagonal boron nitride (h-BN) and other two-dimensional (2D) material nanostripes (NSs) consisting of arrays of quantum dots, films and hybrid nanostructures consisting of NSs and/or films on different rigid and flexible inorganic and organic substrates with atomically flat or stepped (terraced) surfaces is suggested. 2D materials are obtained manually (homemade) or mechanically (for mass production) by rubbing graphite or other layered bulk materials on dielectric, semiconducting and metallic substrates at atmospheric pressure conditions. The combination of microscopic, spectroscopic and electrical characterization techniques, i.e. optical, atomic force (AFM), scanning electron (SEM) and high resolution transmission electron (HR-TEM) microscopy, ultraviolet (UV)–visible, fluorescence (PL), X-ray photoelectron (XPS) and Raman spectroscopy, X-ray diffraction (XRD) and I-V measurements reveal the mechanism of the formation of unique 2D material NSs and films consisting of the NSs on different substrates by defining the efficient rubbing conditions, as well as the requirements to both the substrates and material being rubbed (layered bulk powder, highly ordered pyrolytic graphite (HOPG), fullerene, nanotube). The suggested ecologically clean technology, in contrast to the conventional technologies, drastically decreases the production cost and time, facilitating the making process and avoiding the use of chemicals, solutions and any device, thus paving the way to industrial-scale 2D material production and new applications in next generation ultrathin, lightweight flexible, hybrid and wearable electronics, as well as 2D material enhanced products.

Biography

Gagik Sh Shmavonyan is Full Professor at National Polytechnic University of Armenia. He got his PhD in Physics in 1996 and DSc in Engineering in 2009 at the same university. He did Postdoc at National Taiwan University, Taiwan (2001-2002). He was a Visiting Professor at the University of Hull, UK (2000, 2003), Polytechnic of Milan, Italy (2004-2005), University of Bremen, Germany (2002, 2006), Free University Berlin, Germany (2011), Trinity College Dublin, Ireland (2012), University of Santiago de Compostela, Spain (2013-2014) and University of Cergy-Pontoise, France (2016, 2017). His current research interests are 2D atomic materials, their structures and devices. He has authored more than 100 refereed papers, 20 patents, 4 books and a chapter in a textbook for European students. His most significant reasearch awards are: Cleantech Oscar Award (2015, Silicon Valley, USA); ARPA Institute Invention Competition Awards (2013 and 2014, Los Angeles, USA).

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