

Nanoscience 2019 and Graphene Nanotechnology 2019: Technology for mass production of 2D atomic materials - Gagik Shmavonyan - National Polytechnic University of Armenia, Yerevan, Armenia

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An extremely simple, fast, cost-effective, transfer- and chemical-free, reliable non-conventional substrates rubbing technology for mass production of high quality and large size mono- and few layer graphene, hexagonal boron nitride and other 2D material nanostripes consisting of arrays of quantum dots, films and hybrid nanostructures consisting of nanostripes 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 substrates rubbing technology has advantages over the similar technologies: a) the simplest (one step), can be obtained even by hand, without using complicated nanotechnology equipment, hazardous toxic chemicals and high temperatures, b) the most short-lasting (lasts a few tens of seconds), c) the most cost-efficient (a few times, as no complicated nanotechnology equipment, hazardous toxic chemicals

and high temperatures needed), d) highly productive (production yield is almost 100 % after optimization and production rate is a few g/h or a few tens of tons/year as the rubbing process is extremely fast), e) ecologically clean (no contamination, chemicals, surface doping, contact with any other material), f) controllable, g) universal and unique (any 2D material can be obtained by rubbing technology, which is not achievable with another single technology (a few technologies are needed)).

The substrates rubbing technology allows obtaining unique 2D atomic material a) unique nanostripes and sheets (not achievable with other technologies) with any shape and size on any rigid and flexible inorganic and organic substrates. This unique nanostripes are mono-, few- and multiple atomic layers of exfoliated flakes organized in self-assembled narrow bands of nano-sized quantum dots, which are not reported yet. The nanostripes consist of arrays of quantum dots, while sheets consist of nanostripes, and 2D atomic devices consist of sheets with nanostripes, b) dispersion and powder.