John Parthenios, J Nanomater Mol Nanotechnol 2017, 6:7(Suppl)
DOI: 10.4172/2324-8777-C1-017

2nd World Congress and Expo on

GRAPHENE & 2D MATERIALS

November 06-07, 2017 | Frankfurt, Germany

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Polymer/graphene hybrids as building blocks for flexible touch screens

Thin films supported on substrates are of technological importance and are common place in biological systems such as cell walls and hard skins on soft plant and animal tissues. Stacks of graphene that are laid onto a flat transparent polymer substrate constitute the main part of a flexible touch screen where transparent and conductive electrodes are needed. The number of stacked graphene layers defines the optical transmittance of the screen as well as the conductivity for either resistive or capacitive mode of operation. Both transmittance and conductivity are functions of the quality of the grown graphene layer and, more importantly, of its morphology after the attachment onto the target substrate. Conventional wet transferring techniques involve intermediate carrier films, and therefore several contact and separation events before the deposition of the graphene layer on the target substrate. Such processes result in a transfer-induced texturing of graphene with folds, wrinkles and cracks. In the present work, a systematic investigation is carried out for morphological, mechanical and electrical characterization of graphene stacks on PET substrates. In particular, samples consisted of one, two, three and five graphene layers (nLG) deposited onto a transparent PET film of 125 μm in thickness by the 'bubbling' technique were supplied by BGT materials. By means of SEM and AFM microscopies, the texturing of the PET surface after stacking sequentially a number of graphene layers was identified. The texturing of the 1LG resembles to a thin film under biaxial compression that has been buckled into wrinkles and folds. The subsequent stacking from 2LG up to 5LG results in a different pattern on the PET surface. Within this pattern the folds are broader (~150 nm) and higher (~15 nm) delineating individual domains. Uniaxial tensile tests in combination with Raman microscopy and electrical conductivity measurements were performed to assess the interlayer and the PET/layer adhesive interactions in each stacking configuration and their influence on the hybrid material conductivity. Finally, the optimum number of graphene stacks for a PET/ graphene hybrid is proposed for flexible electronic applications.

Biography

John Parthenios is a Principal Scientist at FORTH/ICEHT, Greece with experience in physics and mechanical properties of graphene, the production of high volume fraction carbon nanotube and graphene based polymer nanocomposites with superior mechanical properties. His expertise covers the production of 2D materials such as graphene and MoS_2 & WS_2 under CVD conditions. He is a Distinguished Member of the Hellenic Physical Society and Co-founder of FORTH Graphene Centre. He has 90 publications in total, 23 refereed books of proceedings and more than 100 conferences.

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