2D VERTICALLY ORIENTED GRAPHENE AND N-DOPED GRAPHENE WITH PLASMA

Uroš Cvelbar[1,2*], Neelakandan Marath Santhosh[1,2], Gregor Filipič[1,2], Oleg Baranov[1,3]

[1] *Jozef Stefan Institute, Ljubljana, Slovenia*
[2] *Jozef Stefan International Postgraduate School, Ljubljana, Slovenia.*
[3]*National Aerospace University, Kharkov 61070, Ukraine*

Plasmas find applications in various fields of materials science including the building of 2D carbon nanostructures like graphene nanowalls (GNW), which is an emerging field of material synthesis with some challenges related to its processing. Synthesis of GNW in a controlled manner with plasma-enhanced techniques opened future pathways for the large-scale, rapid functionalization of graphene for advanced applications. Plasma-supported methods enhance the possibility of processing (synthesis and functionalization) during the surface interactions between substrate and GNW offer the possibility for surface post-treatment. Among the important plasma-assisted methods for GNW synthesis, the most frequently used method is plasma-enhanced chemical vapour deposition (microwave assisted, inductively coupled, capacitively coupled PECVD), which can enable the grow GNW on the substrate even in the absence of metal catalyst [1]. The overall plasma processing of GNW is controlled by using specific gases, typically, CH_4/H_2 are used as the gas systems. Besides these gas systems, there are many others such as $Ar/CH_4/H_2$, $Ar/C_2H_2/H_2$, $Ar/C_2H_2/NH_3$, CH_4/NH_3, and C_2H_2/NH_3 [2]. Functionalization or doping of GNWs is correspondingly an important aspect in the plasma synthesis. There is a large number of research works carried out in the doping process, such as doping with N_2, O_2, B, H_2, Cl and so on. Of course, these results lead to the challenges regarding the plasma-assisted mechanisms and its processing.

This talk addresses the most important challenges associated with plasma-assisted mechanisms of GNWs dealing with the growth and doping of GNWs. From this point of view, it's clear the importance of gas mixtures and plasma's properties. In these systems, plasma parameters including the densities of ions and radicals are regulated by: the discharge parameters including power, gas mixture ratio, gas flow, and pressure. However the main challenge is connected to understanding the role of plasma species in growth and their efficient control for improving the quality and selectively modifying properties of the synthesized GNW. Another challenge is material doping and understanding the mechanism of plasma doping. Nitrogen functionalization and doping are one of the potential directions how to alter the electronic properties, the oxygen plasma treatment, for example, helps to enhance surface morphological properties and widening band gaps, etc. [3]. In this perspective, the talk will highlight the recent progress in the field of building GNW including the processing, functionalization, and future challenges that we have to address in GNW synthesis.

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