# Graphene and 2D transition metal dichalcogenides: synthesis towards applications

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Recently, graphene and two-dimensional (2D) transition metal dichalcogenides open a great potential for direct integration with silicon (Si) technology, due to their outstanding chemical, physical, electronic, and optical properties.

Here, we report the synthesis details of 2D layers using bottom-up techniques, characterizations, and potential applications. In term of graphene, single and multilayers were synthesized using Chemical Vapour Deposition (CVD) method and transferred on varieties of rigid and flexible substrates, analyzed by Raman spectroscopy, optical and electrical measurements. In term of TMDCs layers (as PtSe2, WSe2) an atmospheric pressure thermally assisted conversion (TAC) method of pre-deposited metal layers by Magnetron Sputtering technique was used. The existence of 2D PtSe2 and WSe2 layers were confirmed using X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy analysis. In addition, Optical microscopy (OM) and atomic force microscopy (AFM) mapping of WSe2 revealed the formation of isolated flakes with different shapes, mainly concentrated near the substrate’s edges, which tended to form clusters and to further overlap to continuous layers. Performed photoluminescence measurements confirmed the existence of atomically thin flakes and 2H-WSe2 continuous layers. Spectroscopic ellipsometry were used to determine the thicknesses.

Based on optical and electrical measurements, graphene and selected TMDCs nanolayers has been proposed as supporting conducive electrodes for tunable liquid crystal (LC) phase retarders. The functionality of the assembled LC devices was proved by electro-optical measurements such as threshold and saturation voltage and the phase retardation. Moreover, resistor-like behavior of PtSe2 and WSe2 layers suggested their unlimited prospects for integration into a variety of heterostructures.

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