# Synthesis of textured graphene by laser ablation for surface enhanced Raman spectroscopy and electrochemical sensing applications

Teddy Tite

Advanced Polymer Materials Group, University Politehnica of Bucharest, Romania

Since its discovery, graphene has attracted tremendous interest due to its unique mechanical, thermal, electrical, and optical properties. Graphene has potential applications in many fields, including electronics, energy storage and sensors [1]. It is however clear though the performance of graphene materials is strongly dependent on both the chosen synthesis method, the ability to control its interfacial properties, especially its reactivity and surface chemistry. Recently, it was proposed to convert various solid carbon sources such as amorphous carbon (a-C) into graphene through thermal treatment [2]. However, to date the applications remain largely unexplored. Our purpose was to fill this gap by exploring their surface-enhanced Raman spectroscopy (SERS) and electrochemical applications in the context of strong societal demand in public health and environmental safety.

In the present study, we report the synthesis of textured few-layer (fl) graphene films by pulsed laser deposition (PLD), and highlight their potential applications as Raman and electrochemical sensors. The formation of textured graphene was confirmed by Raman spectroscopy, and surface morphology was inspected by scanning electron microscopy. Gold nanoparticles were deposited on the fl-graphene to investigate its SERS activity. The detection at $10^{-5}$M of deltamethrin and methyl-parathion (MP), active molecules of commercial pesticides, was further demonstrated without the needs of additional chemical treatment found in the literature [3]. Electrochemical properties of graphene samples were investigated by cyclic voltammetry. Electron transfer kinetics obtained with a solution of ferrocenemethanol show a quasi-reversible process with fast transfer rate close to the theoretical limit ($\Delta E \sim 60$mV). The success of covalent surface functionalization by aryl groups, following by the grafting of a large amount of ferrocene groups ($\sim 4.9\times10^{-10}$ mol.cm$^{-2}$), twice than BDD electrode, opens highly promising perspectives for the development PLD graphene electrodes with various sensing functionalities [4]. The method used is relatively simple, and don’t require any need of graphene transfer. We expect that the as-developed fl-graphene substrate will become a practical and powerful platform for molecular diagnostics and will open new avenues for graphene applications.

[1] K. S. Novoselov et al., Nature, 490, 192 (2012).
[2] C. M. Orofeo et al., Nano Res. 4(6), 531 (2011).
[3] T. Tite et al., Appl. Phys. Lett., 104, 041912 (2014) ; Teddy Tite et al. Thin solid films, 604, 74-80 (7 pages) (2016).
[4] P. Fortgang, T. Tite et al., ACS Applied Materials & Interfaces, 8, 1424–1433 (2016).