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Growth and electrochemical characterization of graphene nano walls and carbon nanotubes

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Electrochemical double layer capacitors (EDLC) or supercapacitors exhibit higher specific capacitance than conventional electrolytic capacitors due to their increased surface area and short distance between positive and negative charges at the electrode/electrolyte interface. Because of their high electric conductivity, chemical inertness, thermal and mechanical stability, carbon-based electrodes are the preferred material of choice in supercapacitor applications. In particular, carbon nanostructures such as carbon nanotubes (CNTs), with a high specific surface area may increase the capacitance upto about 100 F/g. Recently, graphene nanowalls (GNWs) are being the focus of research in different areas due to their outstanding properties. GNWs can be described as self-assembled, vertically-standing, few-layered graphene sheet nanostructures. The growth mechanism of these nanostructures is still not clear, but recent results indicate that they grow virtually on every substrate that withstand the synthesis temperature (around 600°C) without the need of a catalyst. Thus, this new material has promising features that may improve performance of energy storage devices like supercapacitors or lithium ion batteries. Surface functionalization of these nanostructures by means of plasma treatments or deposition of metal oxides may further improve their pseudo capacitance and electrochemical performance. This study explores the growth of GNWs and their super capacitive properties grown under different conditions, and compares the results with those obtained for CNTs.

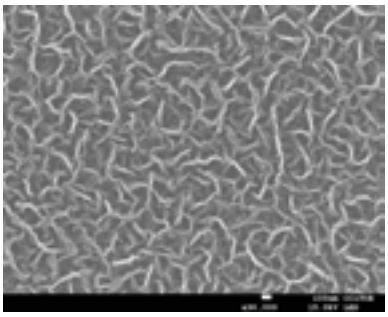

Figure: Top view of Graphene Nanowalls deposited on silicon wafer by means of ICP-CVD (Inductively Coupled Plasma-Chemical Vapor Deposition).

Recent Publications

1. Davami K, Shaygan M, Kheirabi K, Zhao J, Kovalenko D A, Rümmeli M H, Opitz J, Cuniberti G, Lee J S and Meyyappan M (2014) Synthesis and characterization of carbon nanowalls on different substrates by radio frequency plasma enhanced chemical vapor deposition. Carbon Journal 72:372-380.
2. Song X, Liu J, Leyong Y, Yang J, Fang L, Shi H, Du C and Wei D (2014) Direct versatile PECVD growth of graphene nanowalls on multiple substrates. Materials Letters Journal 137:25-28.
3. Bo Z, Yang Y, Chen C, Yu K, Yana J and Cena K (2013) Plasma-enhanced chemical vapor deposition synthesis of vertically oriented graphene nanosheets. Nanoscale 5:5180-5204.
4. Pérez del Pino A, György E, Alshaikh I, Pantoja-Suárez F, Andújar JL, Pascual E, Amade R and Bertran-Serra E (2017) Laser-driven coating of vertically aligned carbon nanotubes with manganese oxide from metal organic precursors for energy storage, Nanotechnology 28(39):1-9.
5. 5. Hussain S, Amade R, Moreno H and Bertran E (2014) RF-PECVD growth and nitrogen plasma functionalization of CNTs on copper foil for electrochemical applications. Diamond and Related Materials 49:55-61.

Biography

Roger Amade has his expertise in the synthesis of carbon nanostructures using chemical vapor deposition (CVD) and plasma enhanced chemical vapor deposition techniques on different substrates and their electrochemical characterization as electrodes for energy storage and production devices. In particular, his research is focused on the development of new nanostructures for supercapacitors, lithium-ion batteries and microbial fuel cells. He is currently an Associate Professor in the Department of Applied Physics from University of Barcelona.

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