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High-quality graphene production from ethanol decomposition using a microwave plasma torch

Graphene is a perfect two-dimensional material with important electrical, mechanical and chemical properties that make this material suitable for a wide range of applications in different scientific and technological fields. Thus, it has been successfully used for manufacturing solar cells or as support for catalysts in the electrodes of fuel cells. Conventional methods as Chemical vapour deposition (CVD) and Liquid phase exfoliation (LPE) have both been applied for graphene production at industrial level. However, microwave plasmas have been reported as efficient, clean, eco-friendly and scalable technology for this purpose using alcohols as precursors. Microwave plasma torches have demonstrated the capability to dissociate the molecules introduced into the discharge, giving place to atoms and radicals. These species can recombine at the plasma exit forming different products to those used as precursors. In microwave plasma torches, the reactions in which the plasma species are involved depend on plasma parameters such as densities and temperatures, whose values can be modified acting on operational conditions used to create and maintain the plasma, thus offering an important degree of control over the final products. Besides, non-intrusive emission spectroscopy techniques can be used to identify the species and radicals formed into the plasma during the precursor decomposition. This fact contributes to understanding the key factors for graphene synthesis using plasma technology. A microwave plasma torch, so-called TIAGO (Torche à Injection Axiale sur Guide d'Ondes), has been used to obtain high-quality graphene 2-7 layers utilizing Ar and ethanol as carrier gas and carbon precursor, respectively. In this way, grapheme powder is directly formed in a single step without requiring any metal catalyst to induce the growing process. In addition, the device and procedure can be escalated at industrial level, adding a new technique for graphene production to those already available.

Biography

María Dolores Calzada has completed her PhD degree in plasma physics from the University of Seville in 1994. She carried out postdoctoral in Group of Plasma Physics Department at University of Montreal, Canada. Since 1997, she joined the department of physics at University of Córdoba, Spain and she is full professor from 2012. Currently, she is Head of the laboratory in innovation in plasmas (LIPs) with research interests on the implementation of new spectroscopy methods for low-temperature plasmas and the application of these ones into hydrogen production, graphene synthesis, analytical chemistry, food conservation, and material treatment.

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