GROWTH OF EXOTIC CARBON NANOSTRUCTURES ON CHALLENGING SUBSTRATES BY CHEMICAL VAPOR DEPOSITION

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ABSTRACT

In the last decades, the technique of Chemical Vapor Deposition (CVD) is commonly used to grow hierarchical carbon structures at nanoscale, not only in academic research, but also in industrial production, given its ability to control the synthesis parameters with ease and low-costproduction [1-2]. Hierarchicalgrowthofnanostructures from gas hydrocarbon precursors is strongly dependent from the geometry and material of the substrate, as well as from the synthesis parameters, such as growth temperature, reaction time, gas flow, the existence and natureof catalyst particles, etc.[3-4]. In this work, we examined the ability of growing carbon nanostructures (amorphous film-2D, nanotubes/nanofibres-1D, nanospheres- 0D, and exotic nanostructures such as nanoflowers, nanofoam, etc) in different substrates, such as wafer Si, stainless steel, ceramic surfaces, alumina (Aluminum oxide- Al_2O_3) and zirconia (Zirconium dioxide-ZrO_2)spheres, absorbent materials (zeolite, nano-alumina), carbon fibres and fabrics. Two main approaches, regarding the catalyst import into the reactor, were followed: the floating and supported catalyst approaches [6].All chosen catalysts contained Ferrum (Fe) as the main metal and were also combined withother transition metals, i.e. Cobalt (Co) and Molybdenum (Mo).Regarding the hydrocarbon precursors, different compounds were used in gas, liquid and solid phase and were chosen according to their chemistry and environmental impact[6].The morphology and structure were investigated through Scanning Electron Microscopy (SEM), Tunneling Electron Microscopy (TEM), X-ray Diffraction (XRD), Raman Spectroscopy and Thermogravimetic analysis (TGA). It was observed that, regarding the material and geometry of the substrate, the structures that are developed, present differences in length, size, thickness, shape, orientation and structural integrity. The successful correlation between the parameters of the CVD process and given substrate, can lead to the design of suitable carbon nanostructures and selective growth, for novel and demanding technological applications, such as in biomedical, sensors, microelectronics, supercapacitors [7], advanced polymer[8] and ceramic[9] composites, coatings[10], environmental (i.e. water purifications) and catalysis. In the above, the economic and productive sustainability is considered, as with a given technique is possible to produce avariety of carbon nanostructures.

ACKNOWLEDGEMNTS

This study was equally supported by the H2020 Projects: "Modified Cost Effective Fibre Based Structures with Improved Multi-Functionality and Performance – MODCOMP" (GA No. 685844) and "Smart by Design and Intelligent by Architecture for turbine blade fan and structural components systems – SMARTFAN" (GA No. 760779)

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