Vertically Aligned Carbon Nanotubes (VACNT): synthesis, characterization and applications for materials, energy and environment

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Doctor in material sciences (1997), HdR (2009), currently in charge of the LEDNA group which is involved in the development and control of the synthesis of nano-objects and nanostructures, as well as in the evaluation of their particular properties for different applications.
Research field: carbon nanostructure CVD growth including nanotubes and graphene, study of their physico-chemical characteristics and properties, growth mechanisms, processing for devices or composite materials. Development of a competitive synthesis process (aerosol-assisted or direct liquid injection CCVD) for VACNT growth on various substrates. Understanding of CNT growth mechanisms (*ex-situ* and *in-situ* studies). Evaluation of properties and applications of such aligned CNT networks. Up-scaling of the VACNT growth process and valorization through NawaTechnologies start-up.
Direction or co-direction of several PhD and post-doctoral fellows. Coordinator or scientific responsible of several national and european projects. Member of the scientific council of SFEC (Société Francophone d'Etude des Carbones), scientific expert for different projects.
Publications: 85 peer-reviewed publications, 9 patents, 15 invited conferences.

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Vertically Aligned Carbon NanoTubes (VACNT) arrays have demonstrated outstanding potentialities as novel material to prepare nanostructured composite or multifunctional materials useful for applications in different fields of high societal interest. To enable a real emergence of such applications, efforts are currently done in order to develop their synthesis and manufacturing process and to reach mass production while decreasing costs. From a technical and economic point of view, the one-step Catalytic Chemical Vapour Deposition (CCVD) process, based on a simultaneous and continuous feeding of the reactor with both catalyst and carbon sources, is a competitive process that could meet the requirement of a low cost and efficient VACNT production.
In this contribution, we will emphasise on our developments in terms of VACNT growth through aerosol-assisted CCVD process at high temperature (800 – 850 °C) or more recently at lower temperature (~ 600°C) enabling to obtain VACNT on various substrates [1-3]. The characteristics of VACNT obtained (arrangement, size, structure, purity) will be reported. We will also demonstrate that this process is scalable and allows getting large substrates covered with VACNT [4], progress which is now ran by NawaTechnologies start-up for mass production.
Such VACNT macroscopic materials can be studied for various applications in different fields. Therefore different methods have been developed in order to generate devices or materials. For instance, VACNT composite can be obtained through a total impregnation of inter-tube space with organic materials [5] and are studied in terms of electrical and thermal properties for various applications such as in the fields of aeronautics, space transportation and satellites (*Collab. ICA Toulouse and Albi, EADS, LSI CEA-Saclay/école polytechnique).*
Nanocomposite electrodes made from electronically conductive polymer (ECP) electrodeposited onto VACNT and filling partially the inter-tube space have been designed and studied for integration in ultracapacitor devices [6] *(Collab. LPPI (University of Cergy Pontoise), PCM2E (University of Tours) ; partnership with NawaTechnologies Company).*
A complementary approach is to disperse VACNT carpets and to process them in order to get devices such as resistive sensors for instance. An additional functionalisation process onto CNT surface enables to get a sensitive response of the sensors against pollutants coming from industry (Cl_2, NH_3) [7] or environment (BTEX). Results in terms of sensor processing and performances will be also presented.

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