Editorial

Fullerene-Related Nanocarbons and Their Applications

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Received 24 July 2012; Accepted 24 July 2012

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The discovery of fullerene (C₆₀) in 1985 spurred on the subsequent discoveries of a number of fullerene-related novel carbons at the nanometre scale. These nanocarbons are related to one another in structure, providing an interesting spectrum of variants which display an array of unique properties. From the vast amount of research that has been conducted over the last two decades, it is now apparent that these nanomaterials, notably, carbon nanotubes, carbon-based nanoparticles, graphene, fullerene and fullerene derivatives promise very distinct applications and will add great value to industries. It is thus expected that the studies on these nanocarbons and related technologies will have huge impacts on future nanotechnology and will significantly contribute to our economy and society.

The research in the field is at the crossroads between different technologies and disciplines involving materials science, chemistry, physics, engineering, and nanotechnology. Its implementation will greatly benefit new, high-tech industries and also help the transformation of traditional carbon-based industries from a resource-intensive to a knowledge-intensive base. However, major challenges exist in the area, which are mainly associated with providing answers to key questions such as how to control the nanostructures, how to produce them in commercial quantities but at relatively low costs, and how to apply them by specific requirements. In this special issue on fullerene-related nanocarbons and their applications, contributions from a broad field of research

have been received from worldwide scientists. The published works are briefly outlined as follows.

The paper by C. H. Lin et al. is a report on the effects of doping graphene in poly(3,4-ethylenedioxythiophene): poly(styrene sulfonate), PEDOT:PSS, as a PEDOT:PSS/graphene nanocomposite hole injection layer on the performance enhancement of polymer light-emitting diodes. The devices are fabricated with the nanocomposite layer, and the influence of the doping concentration on the device performance is examined by measuring the device output properties. Another paper by N. A. D. Yamamoto et al. addresses a similar topic in the field of photovoltaic devices, where the authors investigate the photovoltaic properties of a FTO(anode)/PEDOT:PSS/FT82/C₆₀/Al (cathode) bilayer device by changing the film thickness of the polymer FT82 at the heterojunction with fullerene C₆₀. Here, FTO and FT82 denote fluorine tin oxide and poly(9,9-dioctylfluorene-*alt*-bithiophene), respectively. The current-voltage characteristics of this bilayer cell follows the Mott-Gurney law of space charge limited current, suggesting that the charge transport property of the bilayer photovoltaic device is of the polymer/C₆₀ interface.

There are five papers in this special issue dealing with a research area of fullerene nanowhiskers, metal-doped fullerene nanowhiskers, and single-crystal fullerene nanotubes. Two of the papers by T. Kizuka et al. investigate, by *in situ* transmission electron microscopy and measurements

of the loading forces with an optical deflection technique, the Young's modulus of single-crystal fullerene nanotubes and nanowhiskers composed of C_{70} molecules. The other two papers by T. Kizuka et al. are on the synthesis and characterisation of Fe or Ni-doped C_{60} nanowhiskers using a liquid-liquid interfacial precipitation method. Interestingly, the nanowhiskers have been observed to be able to transform into metal-encapsulated carbon nanocapsules or carbon nanotubes by heat treatments.

The paper by R. Kato and K. Miyazawa describes a photopolymerization phenomenon of C_{60} nanowhiskers. The authors report that the nanowhiskers can be polymerised by a laser beam, associated with a Raman spectrometer, at an appropriately high laser energy dose. The polymerized material is expected to exhibit a higher mechanical strength and a better thermal stability compared with its pristine state, a topic which deserves further studies in the future. The final paper by J. S. Soares and A. Jorio addresses how carbon nanotube properties can be affected by the surrounding environment from both a theoretical and experimental perspective. The changes in parameters such as the optical transition energy and the resonance frequency of a nanotube as a consequence of its interaction with the substrate are analyzed in this work. In addition, the transitions between metal and semiconducting properties of single-walled carbon nanotubes are explained by the tube-substrate bonding effect.

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