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Editorial

1D Nanomaterials

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The advent of nanoscience and nanotechnology is widely regarded as coming to fruition at the result of two key papers. The first in 1985 reported an intriguing artefact of stabilisation of carbon clusters from high temperature plumes [1], though fullerene molecules have since been discovered created by shockwave in a 1.28 billion-year-old impact site [2]. The second in 1991 reported detailed images of what was later termed carbon nanotubes [3], although a comprehensive search of past papers [4] uncovered reports of carbon nanotubes in 1976 and 1952 [5, 6] and a further discovery that a seventeenth century Damascus steel sword contained carbon nanotubes [7]. Whilst it is important to properly ascertain the history of nanoscience, the papers of Kroto et al. and Iijima are no less deserving of their estimable renown.

It should be without any doubt that nanoscience and nanotechnology has had a significant global impact in redefining existing and developing novel research avenues over the last two decades. Where bottom-up assembly meets conventional top-down refinements, nanomaterials proffer the necessary bridge between atomistic processes and useable macroscale devices. Focus has largely been towards preparative methods with specific interest in controlling the fundamental properties and architecture, where the inextricable link between size & geometry and properties of one-dimensional (1D) nanomaterials, for example, nanotubes, nanowires, nanorods, reveals a wide variety of promising applications. It is hoped this will in turn unlock the potential of such nanomaterials in devices. In this special issue on 1-dimensional nanomaterials, we have invited a number of authors to address such matters and thus provide an up-to-date consideration of the field.

The first paper, by Sivakumar et al. [8], appraises the synthesis of carbon nanotubes via chemical vapour deposition (CVD) techniques. They explore the different types of CVD growth available, the influence of catalytic particles and reaction conditions. The second paper, by Hu et al. [9], report the use of "green" chemistry in the non-toxic and non-hazardous large scale CVD synthesis of carbon nanotubes with uniform diameters. This facile approach should prove useful for industrial scale-up in an increasingly environmentally conscious market. The third paper, by Liu et al. [10], examines carbon nanotube-metal oxides composites, where the formed MgO nanorods are determined to facilitate the growth of the encapsulating carbon nanotube. This is an important avenue of exploration where control over the length, diameter and geometry of carbon nanomaterials is important.

Template growth of nanomaterials has proven a useful methodology for controlling the architecture and in turn the properties of nanomaterials [11]. The fourth paper, by Dai et al. [12], explores such a route in the formation of coaxial CdSe-SiO_x nanocomposites with the potential of controlling the final electronic properties. The fifth paper, by Suzuki et al. [13], presents a removable template growth of silica and titania in a one-pot approach that promises to be useful for the generation of nanosize systems. Temporary templates have also been demonstrated to prove useful for nucleation of nanomaterials where Gan et al. [14], in the sixth paper, explored the biomimetic assembly of ZnO on top of gelatin, which then spontaneously formed into 3-dimensional nanostructures.

A number of other approaches have been investigated for the formation of inorganic nanostructures [15]. The seventh paper, by Ding et al. [16], investigates the co-precipitation of indium tin oxide nanoparticles. Thermal evaporation heightens the stochastic energetics of chemical fragments, which has the greatest potential of diversifying nanoscale architecture on cooling. The eighth paper, by Peng et al. [17] and ninth paper, by Ban et al. [18], uses thermal evaporation techniques leading to the generation of elegant hierarchical ZnO and MoO_3 nanostructures respectively.

Both high temperature and high pressure treatment on existing nanomaterials can alter their crystal phase, which is potentially useful for a range of purposes from heterogeneous catalysis to piezoelectronics [19]. The tenth paper, by Ou et al. [20], addresses high temperature crystal phase alterations for titanate and its resulting enhancement of its photocatalytic degradation of chlorinated hydrocarbons. The eleventh paper, by Gao et al. [21], looks at the density functional treatment of ZnO nanowires at high pressures, converting from wurtzite to a rocksalt structure. The phase transformation should prove useful in exploring electronic, piezoelectric and photoconducting applications. Bao et al. [22] in the twelfth paper investigate the high temperature chemical transformation of orthorhombic GaOOH nanorods into wurtzite GaN nanorods, a useful compound for optical devices operating at blue and ultraviolet wavelengths and in high-temperature electronic devices.

At the other end of the scale, the development of red-emitting phosphors and field emission display devices shows great promise from the synthesis of Eu-doped Gd_2O_3 nanowires. Liu et al. [23], in the thirteenth paper, explore the use of solvothermal techniques for the formation of these doped nanomaterials, which (along with hydrothermal techniques) represents a facile approach that could be used to synthesize other rare earth oxide materials. This is demonstrated in the fourteenth paper, by Han et al. [24], in the formation of Mn-doped ZnSe nanowires and also by Yu et al. [25], in the fifteenth paper, where a review of phosphate nanowires doped with rare earth elements are considered. These composites exhibit great promise in the development of biological probes, photonic crystals and optical communication devices.

The final paper, by Yang et al. [26], looks at the fundamental correlation of magnetism with the size of Co nanowires, revealing that the magnetic property can be adjusted through changing the diameter of the nanowire. This is an important discovery for the fabrication of high-density magnetic recording devices.

The breadth of advancement of nanomaterials and their incorporation into useable products has been both extensive and intensive since their inception [27]. Whilst this special issue could not cover every aspect, it endeavours to provide exciting insight into a number of key avenues.

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