Editorial

Recent Advances in Nanocarbon Materials

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Since the discoveries of fullerenes [1] and carbon nanotubes [2], there have been many exciting scientific and technological developments in the field of nanocarbon materials. The pioneering work by K. S. Novoselov et al. [3] on graphenes, which are prepared via mechanical exfoliation of graphites, opened up a new research direction and accelerated research on nanocarbon materials. The unique structures and novel properties of nanocarbons have attracted attention not only in terms of their basic science, but also because of their potential applications in many fields, for example, electronics, energy devices, nanocomposites, and biomedical engineering. This special issue contains nine selected papers that cover a wide range of recent advances in studies of nanocarbon materials. Here, we briefly highlight the topics covered in these articles.

S. Ushiba et al. report the alignment of single-wall carbon nanotubes (SWCNTs) in bubble imprints, which were characterized using polarized Raman microscopy. They found that there are three patterns of SWCNT alignment in the imprints: radial, azimuthal, and random orientations, which are found at the near boundary, on the coffee ring, and at the center, respectively. H. Ueno et al. report the antioxidant activities of hydroxylated fullerenols against lipid peroxyl radicals, determined using a β -carotene bleaching assay. The antioxidant activity varied from 32 to 70% on changing the number of hydroxyl groups, and both low-hydroxylated $C_{60}(OH)_{12}$ (70.1%) and highly hydroxylated $C_{60}(OH)_{44}$ (66.0%) showed high antioxidant activities. P. Slobodian et al. report the sensing of volatile organic compounds by multiwall carbon

nanotube (MWCNT) networks of randomly entangled pristine nanotubes or nanotubes functionalized by *n*-butylamine; these were deposited on a polyurethane-supported electrospun nonwoven membrane. The sensing of volatile organic compounds by functionalized nanotubes was significantly better than that by pristine nanotubes. They also found that the improvement was highly dependent on the used vapor polarity.

The evaluation of the molar absorbance coefficients of metallic, semiconducting, and (6,5)-chirality-enriched SWCNTs, using a spray technique combined with atomic force microscopy, is reported by S. Kuwahara et al. In the visible region, all coefficients had similar values, around $2\text{--}5 \times 10^9/\text{mL mol}^{-1} \text{cm}^{-1}$. They also found that the absorbance coefficients of SWCNTs were independent of their electronic type and chirality but were proportional to their length. T. Wada et al. report the synthesis of layered graphenes via hydroxylation of a potassium-graphite intercalation compound (KC_8) produced from exfoliated graphite flake powder. The obtained samples consisted of a few layers of graphene of area $20\text{--}100 \mu\text{m}^2$ and thickness 1.7 nm; these samples are thinner than those obtained from natural graphite. J. Park et al. observed reverse nonequilibrium molecular dynamics in an investigation of thermal resistance across interfaces comprising dimensionally mismatched junctions of single-layer graphene floors with (6,6)-SWCNT pillars in three-dimensional carbon nanomaterials. They found a significant interfacial thermal resistance in the out-of-plane direction but negligible resistance in the in-plane

direction along the graphene floor. The interfacial thermal resistance in the out-of-plane direction is understood to be caused by changes in dimensionality, and phonon spectra mismatches as the phonons are propagated from the SWCNTs to the graphene sheet and then back to the SWCNTs.

J. M. Tan et al. report an *in vitro* sustained-release formulation of silibinin, based on commercially available carboxylated MWCNTs, and the cytotoxic action of a synthesized silibinin-MWCNT nanohybrid. The release of silibinin from the COOH-MWCNT nanocarrier was sustained and pH dependent. The results showed that the cytotoxicity of the silibinin-MWCNTs to human cancer cell lines was higher than that of free silibinin at low concentrations. Rahman and Mieno report a new and safe method for functionalizing MWCNTs with fewer surface defects, which significantly increases their dispersibility in water. The MWCNTs were pretreated in pure ethanol using a supersonic homogenizer, wetted using citric acid solution, and then treated with a radio-frequency oxygen plasma. Many carboxyl functional groups were attached to the MWCNT surfaces, and a stable dispersion of MWCNTs in water was obtained. D. Ogawa et al. report the encapsulating thermally fragile tris(η^5 -cyclopentadienyl)erbium (ErCp_3) molecules in SWCNTs, in high yield. Structural determination using high-resolution transmission electron microscopy observations and image simulations showed almost free rotation of each ErCp_3 molecule in the SWCNTs.

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