Soft Carbon and Graphite Nanotubes for Electronic Applications

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Utilization of π-electronic conjugation has become of increasing importance in materials sciences, particularly, for molecular electronics, and a variety of molecules and substances, which show interesting optoelectronic properties, have been reported so far. In 2003, we found that bucky gels, prepared by grinding single-walled carbon nanotubes in imidazolium ion-based ionic liquids [1, 2], serve as highly powerful capacitors, and can be applicable to the fabrication of fully plastic actuators by layer-by-layer casting [3] and stretchable electronics [4, 5]. There are many other potential applications, as summarized in our recent review article [6]. In 2004, we have also reported that an amphiphilic hexa-peri-hexabenzocoronene self-assembles into graphite nanotubes [7], which are highly interesting as designer electronic nanomaterials [8]. Later, we succeeded in obtaining a pseudo-crosslinked version of this graphite nanotube by ADMET-triggered self-assembly of an allyl group-appended new amphiphilic hexa-peri-hexabenzocoronene [9]. More recent examples include photo [10], redox [11], and coordination chemistry [12] - mediated stabilization of the graphite nanotubes. These developments will allow for enhancing the practical utilities of these assembly-based nanomaterials. Use of a chiral amphiphilic hexa-*peri*-hexabenzocoronene with stereogenic centers results in the formation of graphite nanotubes with one-handed helical chirality [13, 14]. Water-dispersible graphite nanotubes and surface-polymerized graphite coils have also been fabricated [15-17]. The most recent achievement includes the successful fabrication of a photoconductive graphite nanotube with a coaxial architecture [18, 19]. By using click chemistry, dendrons can be grafted on selectively on the exterior surface of the nanotubes, allowing for the second click reaction selectively in their interior [20]. Very recently, by using a synchrotron facility, we succeeded in complete structural analysis of the graphite nanotubes [21]. We also started a new project for liquid crystalline materials for electronics [22–24]. The most recent example along this line highlights a bawl-shaped corannulene derivative, forming a hexagonal columnar LC mesophase, which perfectly responds to an applied electric field.

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