Multilayered Opportunities in Defective Nanocarbons

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Carbon nanomaterials including fullerenes, carbon nanotubes, and graphenes represent the most important class of materials today; their unique physical and chemical attributes advance their roles across most advanced scientific and technology platforms. Among them, chemically exfoliated version of graphene, graphene oxide nanosheets are receiving interests for their various surface functional groups while preserving some intrinsic properties of graphene. In this talk, our recent effort in the development of defective nanocarbons and their applications in various fields of energy will be highlighted.

In the first part of the talk, I will describe the efforts of past 7 years in developing graphene-based hybrid nanomaterials based on layer-by-layer (LbL) self-assembly techniques. LbL assembly has been widely used as a versatile method for fabricating multilayer thin films of various materials with a controlled architecture and composition at a nanometer scale precision. Specifically, the hierarchically self-assembled graphene superstructures for potential material applications such as transparent conducting thin films, transistors, electrocatalysts, and biosensors will be presented briefly together with our on-going effort in the control over the charge and the dimension of graphene oxide for highly tunable electrode and membrane assembly.

In the second part of the talk, I will describe another branch of our research focused on defective carbon nanodots (CDs). As a benign alternative to semiconducting quantum dots, CDs have recently received considerable attention by virtue of their interesting physical, optical, and chemical properties, such as their photoluminescence, photostability, and electron transfer behavior. A couple of representative examples of utilizing these interesting physical and chemical aspects of CDs will be highlighted in the field of targeted photodynamic therapy and tunable optical behaviors.