Asia Pacific Nano Congress 2019: Carbon Dots in Nanomedicine

Roger M Leblanc

University of Miami, USA

Abstract

Carbon Dots (CDs) with size less than 10 nm have recently triggered great attention in the research of materials science and engineering due to their unique properties. They have been widely explored for applications for printing, bio imaging, drug delivery, thermoelectric materials, photocatalysis and biomedical engineering. These CDs were prepared from both top-down and bottom-up strategies and rigorously characterized by spectroscopy (UV-vis, fluorescence, FTIR and XPS), microscopy (AFM and TEM) and other (e.g., mass spectroscopy, zeta potential, etc.) commonly used techniques. A major medical challenge one faces to treat Central Nervous System (CNS) related diseases is to cross the blood-brain barrier. Recently, the in vivo experimental observations suggested that plenty of CDs could enter the CNS of zebrafish and rats with different mechanisms. Thanks to the abundant presence of carboxylic acids on the surface, CDs are easily conjugated with transferrin and anticancer drugs Doxorubicin. The system was proved to be an effective drug delivery system for the delivery of doxorubicin into cancerous cells. The study has shown that CDs with low quantum yield dark bind to calcified bone structures of live zebrafish larvae with high affinity and selectively. Binding resulted in a strong enhancement of photoluminescence that was not observed in other tissues, including non-calcified endochondral elements. Retention of CDs by bones was very stable, long lasting and with no detectable toxicity. Further, it is shown that this high affinity and specificity binding property towards bone is unique to the CDs developed in the lab, selective CDs in literature did not show any interaction with the bone. These observations support a novel and revolutionary use of CDs as highly specific drug delivery carrier. Thermoelectricity refers to phenomena by which thermal energy is converted directly into electrical energy without any moving parts or working fluids. Significant efforts have been devoted to developing materials that could improve the conversion efficiency. Recently discovered that the addition of CDs could improve the conversion efficiency of thermoelectric materials by as much as 70%, which is unprecedented.

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