

Carbon dots: New Biomaterials in Surface Science [†]

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Abstract: Carbon dots (CDs) with size less than 10 nm have recently triggered great attention in the research of material science and biomedical engineering due to their unique properties such as small size, excellent photoluminescence (PL), high water-dispersity, biocompatibility, nontoxicity, and abundant surface functionalities. In this presentation, I will firstly introduce diverse preparations for CDs. Extensive structural characterizations have been used to hypothesize comprehensive structural models for 3 distinct CD species that represent both top-down and bottom-up approaches in order to optimize their properties and applications.

Then, I will mainly focus on many excellent biomedical applications of the CDs recently developed in our lab: (1), in vivo experiment suggested that glucose-based CDs could cross the blood-brain barrier (BBB) due to the presence of glucose transporter proteins on the BBB; (2), a drug delivery system of carbon nitride dots conjugated with an anti-cancer therapeutic drug and a targeting molecule was capable of effective treatment against diffuse large B-cell lymphoma both in vitro and in vivo revealing efficient therapeutic capabilities with minimal toxic side effects; (3), metformin-derived CDs showed a unique nucleus targeting property, which suggests a huge potential for future nucleus-targeting drug delivery; (4), CDs have constantly shown the capability to inhibit the formation of amyloid precursor protein (APP), beta-amyloid (A β) and A β fibrils. CDs are promising nanomedicine and drug nanocarriers to treat Alzheimer's disease (AD); (5) a pilot study showed a versatile nanocarrier could be assembled via the direct conjugation between distinct CDs to fulfill multitasks.

Keywords: carbon dots; drug nanocarrier; drug delivery system; blood-brain barrier penetration; lymphoma treatment; nucleus targeting drug delivery; alzheimer's disease treatment; nanoparticle assembly.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.