Clemson University Research Foundation

Luminescent Carbon Dots for Optical Imaging (2005-042)

Fluorescing Carbon Particles Identification, Tagging, Visual Separation and Other Purposes

Market Overview

Carbon dots (also called “carbon quantum dots”, “carbon nanodots”, etc.) represent a new class of photoactive nanomaterials that compete effectively with semiconductor quantum dots, a market that was valued at $961.4 million in 2013 and is projected to be larger than $5 billion in 2020. In addition to being benign and nontoxic, carbon dot performance is comparable to the much more expensive fullerene-based materials used in various optoelectronic devices. Carbon dots can be produced from abundant and environmentally-friendly precursors, and thus are suitable for low to ultralow cost applications. Carbon dots brightly fluoresce across the entire visible spectrum and near-IR, making them ideal for serving as fluorescence probes for bioimaging. The uniquely small size of quantum dots enables them to go anywhere in the body, making them suitable for bio-medical applications like medical imaging, biosensors, cell separation, etc.

Application

Healthcare & biotechnology research,
General optical imaging

Stage of Development

Proof of Concept

Advantages

- Available in a wide variety of bright colors visible to the naked eye, making them ideal for medical imaging
- Small-sized with zero dimensionality, allowing them to be used anywhere within the body or electronic devices
- Relatively inexpensive, reducing costs when compared to currently-used technologies

Technical Summary

This quantum dot technology can be comprised of a single material with uniform internal compositions, such as chalcogenides of metals like cadmium, lead or zinc. The photo- and electroluminescence properties of core-type quantum dots can be fine-tuned by simply changing crystallite size. The luminescent properties of quantum dots arise from the recombination of electron hole pairs through radiative pathways. However, excitation decay can also occur through non-radiative methods, reducing the fluorescence quantum yield. One of the methods used to improve efficiency and brightness of these semiconductor nanocrystals is growing shells of another, higher-band gap semiconducting material around them. These quantum dots with small regions of one material embedded in another with a wider band gap are known as core-shell quantum dots (CSQDs) or core-shell semiconducting nanocrystals (CSSNCs). Coating quantum dots with shells improves quantum yield by passivizing non-radiative recombination sites and also makes them more robust to processing conditions for various applications.

App Type	Country	Serial No.	Patent No.	CURF Ref. Number	Inventors
Utility Divisional	United States	11/814,410 12/892,117	7,829,772 8,932,877	2005-042	Dr. Ya-Ping Sun

About the Inventor

Dr. Ya-Ping Sun is the Frank Henry Leslie Professor of Materials and Organic Chemistry at Clemson University. He earned his Ph.D. at Florida State University and was a postdoctoral fellow at the University of Texas at Austin prior to joining Clemson in 1992. Dr. Ping is the author of numerous publications and holds one issued patent.

For More Information

To learn more about this technology, please contact:

Chris Gesswein

Technology Commercialization Officer

agesswe@clemson.edu

(864) 656-0797