Environmental Impact Reduction through the Utilization of Organic Waste for Carbon Quantum Dot-Based Serotonin Sensing

Seyed Hossein Mir Hosseini

İzmir Katip Çelebi University, Department of Nanoscience and Nanotechnology, 35620, İzmir, Türkiye

Ahmet Aykaç

Izmir Katip Çelebi University, Department of Engineering Sciences, 35620, İzmir, Türkiye

Abstract:

Serotonin is an essential neurotransmitter for mood regulation as well as cognitive functions. The highly selective detection of serotonin plays an important role in neuroscience studies and clinical diagnosis. Many studies have been carried out in recent years on the detection of seratonin. But especially the use of nanostructured materials as one of the components of biosensors has become very popular. Nanowires, nanocages, nanoparticles, and quantum dots (QDs) as nanomaterials are among the most frequently used materials in biosensor applications. Among the most important reasons why quantum dots are frequently preferred are their large surface area, additionally QDs possess unique excellent optical properties and chemical properties, including broad excitation spectra, adjustable particle sizes, superior signal brightness, and extended fluorescence lifetime. their functionalization, and their interaction with light.

Herein, we report the synthesis, characterization and biosensor applications of organic waste material-based carbon quantum dots (CQDs) from two different organic waste materials. Watermelon and orange peels were used as carbon sources for the synthesis of CQDs. CQDs were prepared using microwave-assisted techniques (MW) and hydrothermal methods to achieve a fast route at low cost. The synthesized CQDs were characterized using UV-Vis spectroscopy, scanning electron microscopy (SEM), dynamic light scattering (DLS) and Fourier-transform infrared spectroscopy. The obtained CQDs were used for the detection of serotonin by UV-Vis spectroscopy. The preliminary results are very promising and clearly demonstrate that CQDs from organic waste compounds can be used for UV-Vis selective detection of serotonin. This work is pioneering for neurological studies in sustainable manufacturing, advanced nanomaterial synthesis and the development of eco-compatible sensing strategies from research to healthcare.