Synthesis of Carbon Quantum Dots and How Their Characteristics Allow for the Detection of Metal Impurities in Water

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Carbon-based quantum dots were synthesized using both bottom-up and top-down methods to explore their various applications within bio-imaging, bio-labeling, optoelectronic devices, and sensors. For the bottom-up process table sugar, acetic acid, and sodium bicarbonate/sodium hydroxide were mixed to create carbon dots that yielded a green luminescence. For the top-up process, ethanol and sodium hydroxide were subject to a graphite electrolysis process at variant currents. A clear solution was obtained and by filtering it through column chromatography using silica gel, diethyl, and petroleum ether solutions. The UV/Vis spectra were obtained using a Ultrospec 3000 spectrometer for all of the samples. The spectrometer revealed that the samples had an absorbance peak around 330 nm providing evidence of sufficient quantum dots. The bandgap energy of the quantum dots was obtained using the Tauc method and found to be in the range of 3.1 eV. The quantum dots created from the "top-down" and "bottom-up" methods possess fluorescent and semiconducting properties that allow them to be reliable detectors of metal impurities in water. When quantum dots are in the presence of metal impurities, the fluorescence they emit is quenched and the absorption peaks disappear which proves their ability to detect metal impurities.