Facile hydrothermal and solvothermal synthesis and characterization of nitrogen-doped carbon dots from palm kernel shell precursor

ABSTRACT

Carbon dots (CDs), a nanomaterial synthesized from organic precursors rich in carbon content with excellent fluorescent property, are in high demand for many purposes, including sensing and biosensing applications. This research focused on preparing CDs from natural and abundant waste, palm kernel shells (PKS) obtained from palm oil biomass, aiming for sensing and biosensing applications. Ethylenediamine and L-phenylalanine doped CDs were produced via the hydrothermal and solvothermal methods using one-pot synthesis techniques in an autoclave batch reactor. The as-prepared N-CDs shows excellent photoluminescence (PL) property and a quantum yield (QY) of 13.7% for ethylenediamine (EDA) doped N-CDs (CDs-EDA) and 8.6% for L-phenylalanine (L-Ph) doped N-CDs (CDs-LPh) with an excitation/emission wavelength of 360 nm/450 nm. The transmission electron microscopy (TEM) images show the N-CDs have an average particle size of 2 nm for both CDs. UV-Visible spectrophotometric results showed C=C and C=O transition. FTIR results show and confirm the presence of functional groups, such as -OH, -C=O, -NH2 on the N-CDs, and the X-ray diffraction pattern showed that the N-CDs were crystalline, depicted with sharp peaks. This research work demonstrated that palm kernel shell biomass often thrown away as waste can produce CDs with excellent physicochemical properties.

Keyword: Carbon dots; Photoluminescence; Palm kernel shell; Dopants; Quantum yield