World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:14, No:04, 2020

White Light Emitting Carbon Dots- Surface Modification of Carbon Dots Using Auxochromes

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Abstract : Fluorescent carbon dots (CDs), a young member of Carbon nanomaterial family, has gained a lot of research attention across the globe due to its highly luminescent emission properties, non-toxic behavior, stable emission properties, and zero re-absorption lose. These dots have the potential to replace the use of traditional semiconductor quantum dots in light-emitting devices (LED's, fiber lasers) and other photonic devices (temperature sensor, UV detector). However, One major drawback of Carbon dots is that, till date, the actual mechanism of photoluminescence (PL) in carbon dots is still an open topic of discussion among various researchers across the globe. PL mechanism of CDs based on wide particle size distribution, the effect of surface groups, hybridization in carbon, and charge transfer mechanisms have been proposed. Although these mechanisms explain PL of CDs to an extent, no universally accepted mechanism to explain complete PL behavior of these dots is put forth. In our work, we report parameters affecting the size and surface of CDs, such as time of the reaction, synthesis temperature and concentration of precursors and their effects on the optical properties of the carbon dots. The effect of auxochromes on the emission properties and re-modification of carbon surface using an external surface functionalizing agent is discussed in detail. All the explanations have been supported by UV-Visible absorption, emission spectroscopies, Fourier transform infrared spectroscopy and Transmission electron microscopy and X-Ray diffraction techniques. Once the origin of PL in CDs is understood, parameters affecting PL centers can be modified to tailor the optical properties of these dots, which can enhance their applications in the fabrication of LED's and other photonic devices out of these carbon dots.

Keywords : carbon dots, photoluminescence, size effects on emission in CDs, surface modification of carbon dots
Conference Title : ICNN 2020 : International Conference on Nanoscience and Nanotechnology
Conference Location : Paris, France
Conference Dates : April 16-17, 2020