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Synthesis of carbon dots from tropical plant waste

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Carbon dots are nanoparticles with a size less than 10 nm and with a graphitic carbon core [1, 2]. They are very stable, photoluminescent, non-toxic and biocompatible materials [1, 2, 3]. Carbon dots can be used in bioimaging [3], sensing [1], drug delivery [3] and catalysis [1, 2].
The objective of this work is to use tropical plant waste for the synthesis of carbon dots. Sargassum algae, guava seed and square wood were chosen as precursors.
The synthetic methods for carbon dots are divided in two parts, top-down and bottom-up routes. Top-down synthetic route refers to breaking larger carbon structures as graphite to obtain the dots while bottom-up route refers to building the dots from small precursors such carbohydrates, citrate. The top-down method was selected for this work. Carbon dots solutions were manufactured by solvothermal synthesis from the different precursors using different media, water, ammonia, sodium hydroxide and ethanol.
The carbon dots obtained were observed under UV lamp (see figure 1), under transmission electron microscopy and characterized by IR, UV-vis, Raman and fluorescence spectroscopies.
The transmission electronic microscope shows that the shapes of the dots are different and their sizes are heterogeneous. The IR shows the presence of simple carbon-heteroelement bonds in the dots. The UV-visible spectra present two peaks at 220 nm and 270 nm, more or less intense in function of the precursor and the operating conditions. The peak at 220 nm is generally attributed to C=C bonds in the dots while the peak at 270 nm is attributed to carbon-heteroelement bonds in the dots. Under an excitation of 320 nm, the dots give purple to blue fluorescence emission (λmax = 420 to 500 nm).
These results show that efficient carbon dots can be prepared from tropical waste plant and that the photoluminescence properties of dots depend both on the precursor and on the operating conditions. An attempt to explain the fluorescence mechanism of the carbon dots by their surface properties will be done.

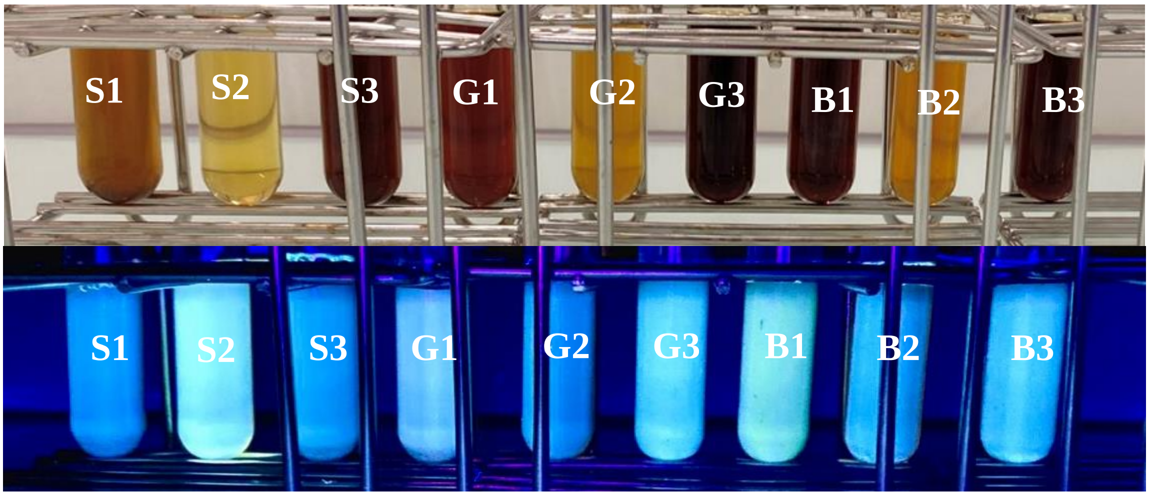

Figure 1: Carbon dots solutions in the daylight and under UV lamp at 365 nm
S for sargassum algae, G for guava seeds and B for square wood; 1 for ethanol, 2 for sodium hydroxide and 3 for ammonia

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