Comparison of xylose-derived and glucose-derived carbon quantum dots (CQDs) prepared by microwave-assisted synthesis

Anna Casadó,[1] María Méndez,[2] Maria Cinta Pujol,[1] Yolanda Cesteros,[1] Joan J. Carvajal[1]

[1]Universitat Rovira i Virgili, Departament of Physical and Inorganic Chemistry, C/ Marcel·lí Domingo, 1, 43007 Tarragona, Spain
[2]Institute of Chemical Research of Catalonia (ICIQ), The Barcelona Institute of Science and Technology (BIST), Avda. Països Catalans, 16, 43007, Tarragona, Spain
anna.casado@urv.cat

The development of technologies to produce energy and chemical products from renewable resources has promoted the valorisation of biomass. Lignocellulose is the most abundant and least expensive of renewable biomass, containing cellulose (40-50%), hemicellulose (25-35%) and lignin (15-20%) [1].
One challenging way of revalorising lignocellulosic biomass is by synthesising CQDs, which are nanomaterials with sizes below 10 nm and attractive properties, such as facile synthesis, high hydrophilicity, chemical stability, and unique luminescent properties [2]. CQDs may have a graphite core and an amorphous shell with carboxyl, hydroxyl, amide, and carbonyl moieties, giving them tuneable photoluminescence (PL) and even up-conversion properties under excitation above 800 nm [3]. CQDs may exhibit strong absorptions in the UV range and visible photoluminescence, with quantum yield exceeding 80% [4].
This work aims to synthesise and characterise CQDs from the lignocellulosic biomass fractions xylose and glucose, obtained by almond shells (Cooperativa Unió Nuts, Reus), using microwaves for a more energy-efficient, faster and greener process than traditional synthesis methods. The unpurified samples were characterized by UV-vis absoption, Zetasizer, Transmission Electron Microscopy (TEM), emission and excitation spectrometry, and the results compared. Special emphasis was put in the optimization of the synthesis conditions, rarely discussed in the literature.
Xylose-derived CQDs were 2-5 nm in size, whereas glucose-derived CQDs were 2-10 nm in size. Slight differences in the PL properties were observed when using xylose or glucose as carbon precursors. Aditionally, their PL properties were different depending on the pH used.

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References

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Figures

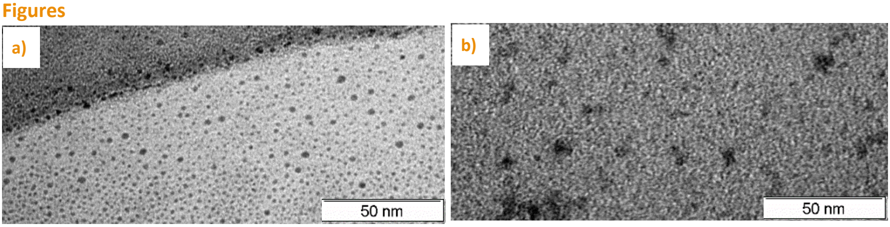

Figure 1: TEM Image of a) xylose-derived CQDs and b) glucose-derived CQDs.