Photocatalytic activity of microporous, structured graphitic carbons

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The most frequent photocatalysts contain metals, commonly some that are considered as critical raw materials, such at titanium. For the sake of sustainability there is an increasing interest in developing metal-free photocatalysts that can be obtained from biomass for the conversion of sunlight into fuels and chemicals. In the presentation, it will be described the use of oligo-/poly- saccharides to obtain structured graphitic carbons. Some of them, as those derived from chitosan using templating agents or from cyclodextrins without templation can be converted by pyrolysis in highly crystalline graphitic carbon residues [1]. Scheme 1 presents the concept of the synthesis of one of these materials, while Figure 1 shows a high-resolution TEM image of other material. These carbon residues exhibit regular (ultra)microporosity of subnanometric dimensions. In addition, these materials can be doped with heteroatoms such as N or P. By controlling the composition and structure of these carbons it is possible to influence the properties and activity of these materials.

Scheme 1. Pictuorial illustration of the preparation of microporous graphitic carbon from chitolsan by soft templation

It will be shown that these graphitic exhibit photocatalytic activity under simulated sunlight illumination to promote overall water splitting into hydrogen and oxygen in stoichiometric amounts. The materials appear as stable and reusable under the conditions of the irradiation (Fig. 2).
Overall these studies show how low value biomass wastes can be converted into useful materials that can exhibit important properties and applications, such as for hydrogen generation from water. Thus the results to be presented are a clear case of valorisation of residues and sustainability.

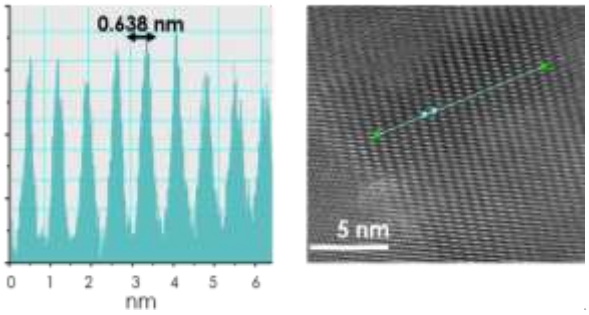

Fig. 1 TEM image of microporous graphitic carbon derived from a-cyclodextrin and periodicity along the green line corresponding to the channel dimension.

REFERENCES

[1] Peng, Y.; Rendon-Patino, A.; Franconetti, A.; Albero, J.; Primo, A.; Garcia, H. Acs Applied Energy Materials 2020, 3, 6623.
[2] Rendon-Patino, A.; Santiago-Portillo, A.; Valles-Garcia, C.; Palomino, M.; Navalon, S.; Franconetti, A.; Primo, A.; Garcia, H. Small Methods 2020, 4. 1900721

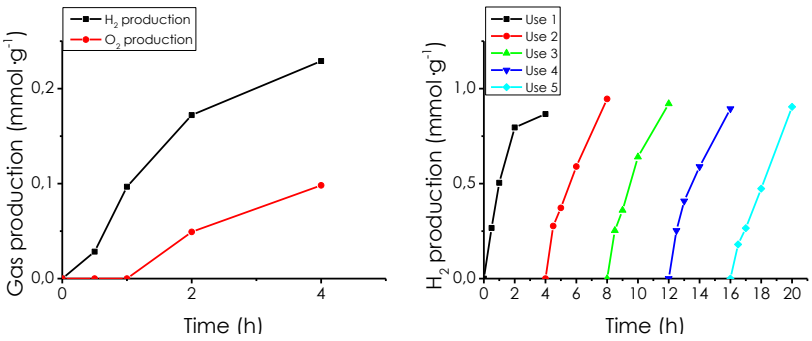

Fig. 2. Temporal profiles of H_2 and O_2 generation upon irradiation with simulated sunlight (1 Sun power) an aqueous suspension of graphitic carbon (1 mg/ml) at ambient temperature. Right: H_2 evolution upon consecutive irradiations under the previous conditions.