TANNINS AS GREEN CARBON PRECURSOR FOR ENVIRONMENTAL AND ENERGY APPLICATIONS

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Tannins are natural polyphenolic molecules that have a number of unique advantages: bio-based, commercially available at low cost, reproducible, non-toxic but reactive. These precursors are the natural counterpart of resorcinol and phenol, from which many carbon aerogels have been described. They can even polymerize without crosslinker by self-condensation, thus leading to formaldehyde-free carbon precursors for example. The exceptional richness of the possible formulations also allows producing thermoset resins of all morphologies, which, once polymerized, are insoluble and infusible and thus make it possible to obtain carbon materials of completely controlled structure.

Tannin-derived carbons can be graphitized, and that the entire series of nanotextures from vitreous carbon to graphite through turbostratic carbon can be obtained. Therefore, not only the most diverse structures are possible by the proper structuring of precursor resins, but also once the carbons are obtained, the performances meet expectations, whether they deal with electrochemistry, adsorption, transport processes or responses to electromagnetic waves for example. This is explained by the control of the porosity by which any architecture is feasible from the same starting raw material on the one hand, but also by the possibility of adjusting the carbon texture on the other hand. Moreover, the resulting carbon is reactive and therefore responds very well to doping and to surface functionalization, further expanding its already broad possibilities of use.

In this talk, I will show that there are a multitude of applications for which these tannin-derived carbons can be successfully used. Supercapacitor electrodes, carbon molecular sieves, platinum-free electrocatalysts for the oxygen reduction reaction in PEMFC fuel cells, adsorption of CO_2, water / hydrocarbon separation, catalysis of ethylene epoxidation, UV photodegradation of dyes, encapsulation of phase change materials for seasonal heat storage, broadband absorption for microwave applications, sound absorption at controlled frequencies, are worth mentioning, amongst others.