# Transformation of Biowaste into highly microporous graphitic carbon for Metal-free catalytic oxygen reduction reaction and capacitive applications.

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Abstract: The ergonomic and slick synthesis methods for raw materials of energy harvesting cum energy storage systems are urgently needed to replace the existing materials due to their low efficiency and vulnerable impact on nature [1,2]. In this work, we have successfully prepared microporous graphitic carbon with self-doped N heteroatom from waste agarwood leaves (AL) through a chemical activation process. The synthesized porous graphitic carbon (ALPC 800) material contains high values of hetero-doped high N (11.23 at%) and O (8.54 at%) contents and exhibits a high surface area (up to 718 $m^2$ $g^{-1}$). Physicochemical properties and confirmation of the microporous carbon were done by powder X-ray diffraction (PXRD), Raman spectroscopy, FESEM and TEM techniques which evidenced a high degree of graphitization. The microporous carbon exhibits excellent electrocatalytic properties for oxygen reduction reaction (ORR) onset potential ($E_{onset}$) of 0.98 V and limiting current density ($J_L$) of 6.2 mA $cm^{-2}$ in $O_2$ saturated 0.1 M KOH and this is on par with the commercially available high cost 10 wt% Pt/C. For energy storage, It shows a high specific capacitance of 421 F $g^{-1}$ at a current density of 1 A $g^{-1}$ in 0.5 M aq. $H_2SO_4$ electrolyte. More prominently, the assembled symmetrical supercapacitor (SSC) device based on the ALPC-800 demonstrated high capacitance retention of more than 90% after 6000 cycles at 1 A $g^{-1}$ with a remarkable energy density of 21.15 Wh $kg^{-1}$ and a power density of 4.93 kW $kg^{-1}$. Thus, this work provides a simple, efficient, and ergonomic method for the conversion of biowaste to high microporous carbon. Being a metal-fee catalyst, heteroatom-doped ALPC-800 carbon material synthesized from biowaste has the potential to replace the commercially available high-cost Pt/C catalyst for fuel cell application which accounts for almost 20-30% of the funds used for fuel cell technology.

Keywords: waste leaves; N-doped graphitic carbon; metal-free ORR; supercapacitor.

References:

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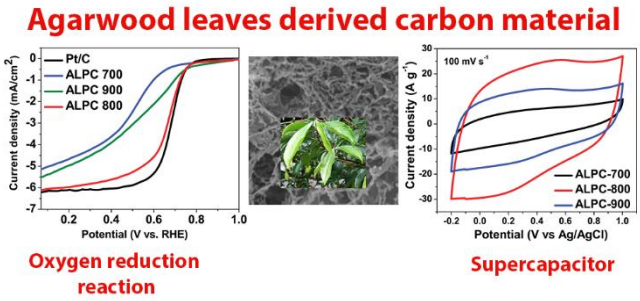


Figure 1: Agarwood leaves into graphitic porous carbon for ORR & energy storage