Hydrothermal Carbonization of Bamboo Waste as a Cathode Electrocatalyst Support for Oxygen Reduction Reaction

Mark Ian S. CASTILLANO[1,*], Larra Gene L. FERNANDO[1], and Ir-shad M. JAUJOHN[1]

[1] Laboratory of Electrochemical Engineering, Department of Chemical Engineering, College of Engineering, University of the Philippines, Diliman 1101, Quezon City, Philippines
* Corresponding author

Submission Category:
(A) Technical research proposal to solve concrete problems

SDGs Targets/Indicators:
SGD 7 - Affordable and Clean Energy
SGD 9 - Industry, Innovation, and Infrastructure
SGD 11 - Sustainable Cities and Communities
SGD 13 - Climate Action

Abstract:

Fuel cell technology plays a pivotal role in the energy transition from being fossil fuel dependent. One of the governing reactions in a fuel cell is oxygen reduction reaction (ORR). Correspondingly, ORR is characterized by its sluggish rate, and the costly Platinum/Carbon (Pt/C) is its prevailing commercially available catalyst. Moreover, in general, catalysts do not function as effectively in the absence of catalyst support; and hence serves as the motivation of this research. Hydrothermal carbonization was explored as the method for the fabrication of the alternative catalyst support. Moreover, bamboo was selected as biomass source for its innately porous structure and abundant supply in the Philippines. In this research, the samples (bamboo stem, leaves, and branches) contained in an autoclave underwent single-pass (12 hours) and double-pass (24 hours) carbonization at 250°C. FTIR, XRD and SEM analyses results manifest the incurred increased porosity and amorphicity of the resultant hydrochars. Furthermore, among the samples, bamboo stem exhibited highest C-C and C=C and lowest C-O absorption peaks indicating most effective carbonization. This result is further substantiated by the cyclic voltammetry test of bamboo stem hydrochar. For these reasons, bamboo stem was concluded to be the most suitable for catalyst support applications. Embedding it with MnO_2 and its utilization for the cathode layer of the hydracell show that the catalyst works with hydrochar from bamboo stem as the catalyst support.