

Lecture 13. Activated carbon materials application in microbial fuel cell

Activated carbon is a porous carbon material that contains macro-, meso-, and micropores and has a high SSA. Activated carbon can be obtained from almost any carbon-containing material of organic origin, but the main carbon source for its production on an industrial scale are charcoal, coal and petroleum coke, rice husks (RHs), coconut shells, and oil palm empty fruit bunches (EFB), wood, nut shells and various plant wastes. In Table 1 activated carbon from different biomass precursors, their SSA and application area are collected. The activated carbon production technology includes two successive stages of carbonization and activation. The carbonization process is a heat treatment of feedstock without oxygen at temperatures from 450 to 650 °C. Activation is carried out at temperatures above 750 °C and two types of activation are mainly used: vapor-phase and thermochemical. The structural composition of the raw material and the conditions of their carbonization, subsequent activation, and modification of their surface have a significant impact on the structure and properties of activated carbon.

Sujiono et al. (Sujiono et al., 2022) fabricated a high-quality microporous activated carbon from coconut shell waste by using different activating agents. They showed the activated carbon-based on an activating agent of NaOH can potentially be applied for water purification treatment. Neerhu et al. (Neethu et al., 2019) developed an affordable low-cost durable proton exchange membrane (PEM) based on activated carbon derived from coconut shell (ACCS) and natural clay for application in a microbial fuel cell.

Table 1

Comparison of S_{BET} of activated carbon from different biomass precursors

Raw material	SSA, m ² /g	Application	Ref.
RH	2696	Supercapacitor electrode	(Teo et al., 2016)
RH	2804-3263	Supercapacitor	(Liu et al., 2019)
RH	1583	Lithium-sulfur (Li-S) battery	(Mai et al., 2019)
RH	2176	Lithium-ion batteries (LIBs)	(Yu et al., 2018)
RH	3292	Electrode materials for supercapacitor	(Yeleuov et al., 2020)
Coconut shell	516	Water purification treatment	(Sujiono et al., 2022)
Coconut shell		Microbial fuel cell	(Neethu et al., 2019)
Oil palm EFB	1704	Electrodes for application in supercapacitors	(Farma et al., 2013)
Oil palm EFB	41-1571	A working electrode in symmetric hybrid supercapacitor	(Larasati et al., 2019)
Oil palm EFB	445-640	For producing electrode materials	(Rustamaji et al., 2022)

Literatures

Sujiono, E.H., Zabrian, D., Zurnansyah, Mulyati, Zharvan, V., Samnur, Humairah, N.A., 2022. Fabrication and characterization of coconut shell activated carbon using variation chemical activation for wastewater treatment application. *Results Chem.* 4, 100291. <https://doi.org/10.1016/j.rechem.2022.100291>