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AS203 FSG

UiTM 2026

SYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE-DOPED ACTIVATED CARBON DERIVED FROM LEMON PEEL WASTE FOR SUPERCAPACITOR APPLICATIONS

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Final Year Project Report Submitted in
Partial Fulfilment of the Requirements for the
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This Final Year Project Report entitled **"Synthesis and Characterization of Zinc Oxide-Doped Activated Carbon Derived from Lemon Peel Waste for Supercapacitor Applications"** was submitted by Ayu Najiha binti A Rashid in partial fulfillment of the requirements for the Degree of Bachelor of Science (Hons.) Physics, in the Faculty of Applied Sciences, and was approved by

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ABSTRACT

ZINC OXIDE-DOPED ACTIVATED CARBON DERIVED FROM LEMON PEEL WASTE FOR SUPERCAPACITOR APPLICATIONS

Activated carbon (AC) is the most common electrode material for supercapacitors, particularly Electrochemical Double Layer Capacitors (EDLCs) because of its high specific surface area which is crucial in providing more sites for ions to accumulate at the electrode-electrolyte interface, leading to a higher charge storage capacity. However, AC has a lower rate capability and poor energy storage capability. Therefore, the objective of this study was to develop a synthesis method for zinc oxide-doped activated carbon (ZnO/AC) derived from lemon peel waste for supercapacitor applications as well as to determine its characterization, both physical and electrochemical properties. Lemon peel waste was used as a precursor for AC, which was prepared through a carbonization process and an activation process that involved the addition of a chemical activating agent, such as potassium hydroxide (KOH), before being doped with ZnO. The value of carbon yield from the carbonization process, and the value of ash content from the activation process were 54.46% and 0.79% respectively. After the doping process was completed, the electrode fabrication and performance evaluation of ZnO/AC were carried out. The value of surface area (physical properties) was obtained from the pure activated carbon of lemon peel (ALP), whereas the values of energy density and specific capacitance (electrochemical properties) were obtained from both ALP and ZnO/AC. For this research, the value of surface area was found to be 2.5609 m^2g^{-1}, with the presence of mesopores within the activated carbon. As for the energy density and specific capacitance, ZnO/AC demonstrated a slightly higher energy density of 1.09 $Whkg^{-1}$, and specific capacitance of 162.21 Fg^{-1} compared to ALP which demonstrated energy density and specific capacitance of 1.06 $Whkg^{-1}$ and 158.31 Fg^{-1} respectively. Hence, ZnO/AC showed the best results due to its higher energy density, and specific capacitance. Overall, this research confirmed that ZnO/AC derived from lemon peel waste had the potential to be a practicable and sustainable electrode material for supercapacitor applications, contributing to green energy storage solutions.

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