PREPARATION AND IONIC CONDUCTIVITY OF Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ USING WASTE CHICKEN EGGSHELLS AS Ca SOURCE FOR ANODE MATERIAL OF LITHIUM ION BATTERIES

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ABSTRACT

Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ has been synthesized as anode material for lithium-ion batteries parallel with Li$_4$Ti$_5$O$_{12}$ anode material using solid state reaction method in an air atmosphere. LiOH.H$_2$O, TiO$_2$, and waste chicken eggshells in the form of CaCO$_3$ were chosen as sources of Li, Ti, and Ca respectively and prepared using stoichiometric. The phase structure, morphology, and electrochemical impedance of as-prepared samples were characterized using XRD, SEM, and EIS. The XRD characterization revealed that in Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ sample, all amount of dopant had entered the lattice structure of Li$_4$Ti$_5$O$_{12}$. The EDX image also detect the existence of Ca in the structure of Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$. The EIS characterization revealed that the Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ sample had lower electrochemical impedance compared to the Li$_4$Ti$_5$O$_{12}$ sample. The diffusion coefficient were obtained by Faraday’s method, and exhibited that the Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ sample (1.46986 x 10$^{-12}$ cm$^2$/s) had higher ionic conductivity than the Li$_4$Ti$_5$O$_{12}$ sample (4.40995 x 10$^{-16}$ cm$^2$/s). According to the cycle performance test, the Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$ sample also had higher charge-discharge capacity and stability compared to the Li$_4$Ti$_5$O$_{12}$ sample.

Keywords: Li$_{3.9}$Ca$_{0.1}$Ti$_5$O$_{12}$; Anode Material; Lithium-ion Batteries; Waste Chicken Eggshell; Ionic Conductivity;