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An enhancement on electrochemical properties of Li^+ ions battery-based PMMA/PLA-LiBOB gel polymer electrolytes

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ABSTRACT

In the present work, the effect of SiO_2 nanofiller on the electrochemical properties of GPEs prepared from PMMA/PLA has been discussed in detail. Two different systems are examined: PMMA/PLA-LiBOB (System I) and PMMA/PLA-LiBOB-SiO_2 (System II). The Cole–Cole plots illustrate a notable reduction in bulk resistance consequent to the incorporation of SiO_2, which results in a substantial improvement in ionic conductivity from 1.69×10^{-6} S cm^{-1} to 1.37×10^{-3} S cm^{-1} at ambient temperature, with the peak conductivity identified at 6 wt.% SiO_2. The dielectric analysis reveals that SiO_2 markedly augmented both the dielectric constant and dielectric loss, attributable to its elevated polarizability and the contributions from space charge polarization. Linear Sweep Voltammetry (LSV) measurements indicate voltage stability of 4.1 V for System I and 4.7 V for System II. Electrochemical performance comparisons demonstrate that System II outperforms System I in terms of stability and cycling performance, with differential capacity analysis further confirming the positive impact of SiO_2 nanofiller on electrochemical activity.

1 Introduction

The Nobel Prize in Chemistry (given in 2019) recognized lithium-ion battery (LIB) technology as the foundation for a fossil-free global power source. Its highly appealing characteristics, such as superior energy density, power density, excellent rate capability, and long cycle life, have made it useful in a variety of devices, including portable electronics, electric vehicles, energy storage systems, robotics, military equipment, emergency systems, and medical devices [1–3]. Since its debut in 1991, modern LIBs have improved battery performance by improving energy density at a rate of 7–8 Wh/kg every year [4]. The prevalent concept of achieving "carbon neutrality" has fueled substantial research and development of lithium-ion

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