

عنوان مقاله:

Mechanistic approach developed to estimation of exchange current density and charge transfer coefficient in lead acid batteries

محل انتشار:

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خلاصه مقاله:

Understanding and accurate estimation of electrochemical parameters play a pivotal role in enhancing the performance and efficiency of electrochemical systems like batteries and fuel cells. The exchange current density and charge transfer coefficient are particularly critical factors as they are directly related to the shape and structure of the battery electrodes and influence the electrochemical processes occurring within electrodes of the battery. Considering a fixed value for these parameters for a type of battery is not accurate due to the varying shapes and structures of electrodes in different batteries. This paper presents a comprehensive mechanistic approach to determine these electrochemical coefficients based on a combination of experimental testing, one dimensional computational fluid dynamics simulation, and optimization. This study focuses on the investigation of a 4 ampere-hour lead-acid battery (IBIZA) with the determination of anodic and cathodic exchange current densities and charge transfer coefficients for both the lead and lead oxide electrodes, respectively. Mentioned parameters are derived for two scenarios (one-step constant current discharge and two-step constant current discharge). The values of α_a , α_c and i_0 for Pb and PbO₂ for scenario one with 0.2 C_{rate} are found to be 1.95, 0.05, 9.99×10^{-3} , 0.05, 1.95 and 3.05×10^{-4} and with 0.2 C_{rate} are 9.98×10^{-3} , 0.75, 1.25, 9.69×10^{-3} , 0.97 and 1.03, respectively. Mentioned parameters for scenario two are found to be 0.6, 1.4, 2.70×10^{-3} , 0.6, 1.4 and 2.40×10^{-4} , respectively.

کلمات کلیدی:

Electrochemical Kinetics, Current Density extraction, Charge Transfer Coefficient estimation, battery simulation

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