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Mercury Intrusion for Ion- and Conversion-Based Battery Electrodes – Structure and Diffusion Coefficient Determination
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Abstract

The electrochemical performance of a secondary battery shows a significant dependency on electrode pore structure since the ionic transport is, beside the electric transport, the crucial transport process in ion based battery systems. Thus, it is necessary to determine and understand the electrode pore structures in detail. One common method to characterize pore size distributions and porosities in solid materials is mercury intrusion. Since battery electrodes are composites of different materials (metal current collector, different fractions of active material and additive particles, binder, and others) the used measurement and calculation methods have to be adjusted. In this work we provide an overview of applying mercury intrusion to determine different electrode pore structure properties: coating porosity, pore size distribution, tortuosity, absolute and specific pore volume, pore volume distribution sum and the inner coating surface. To demonstrate the developed method, a pore structure analysis for a continuous manufactured graphite based electrode with varying compression rates is shown. Furthermore, we show that it is possible to determine a structure dependent diffusion coefficient using mercury intrusion.

0 Introduction

Electrochemical energy storage techniques are thought as a key factor for the e-mobility development and establishment of mass energy storages. Lithium-ion batteries are currently considered as the most promising energy storage technology regarding practicable energy densities.