

QUANTIFICATION OF LITHIUM PLATING IN COMMERCIAL LI-ION BATTERIES VIA IN SITU TECHNIQUES

David Anseán^a, Víctor M. García^{a,b}, Manuela González^a, Juan C. Viera^a, Cecilio Blanco^a

^aBattery Research Laboratory, Department of Electrical Engineering and

^bDepartment of Physical and Analytical Chemistry.

University of Oviedo, Gijón, Asturias, 33204, Spain

email address of the presenting author: anseandavid.uo@uniovi.es

Lithium plating (Li plating) is considered one of the most detrimental phenomenon in lithium ion batteries (LIB) [1–3]. The effects of Li plating can lead to an increase of lithium consumption within the electrode-electrolyte interface due to side reactions [3,4], loss of active material and may also cause safety deterioration [1,5,6]. In addition, Li plating is considered one of the most complex phenomena to analyze in LIBs. Due to its importance, recent studies [3,7–10] have focused on the topic of Li plating on LIBs, aiming to further elucidate its effects and, most importantly, to detect it. However, to our best knowledge, an advanced, *in situ* and cost-effective technique to detect and quantify Li plating still remains lacking.

In this study, we will show an analysis to estimate Li plating via *in situ* techniques on a commercial high power LiFePO₄ cell under stressful, long-term testing conditions. Fig. 1a shows the evolution with cycle of the incremental capacity (IC) curves at C/25 for the tested cell. The use of IC curves allowed us to identify the presence of Li plating, as Peak 0 emerged after cycle 600. In combination with the IC peak area (PA) analysis [11], we were also able to quantify the amount of capacity underneath Peak 0. To further quantify the effects of Li plating, we carried out computer simulations using ‘Alawa battery diagnosis and prognosis toolbox [12]. Additional analyses and computer iterations allowed us to estimate the effects of Li plating during operation (i.e. online). The outcomes of these analyses are shown in Fig. 1b, which reveals the effects that the degradation modes caused on each individual electrode throughout cycling. We observed that Li plating abruptly reduces the capacity retention by a factor of three. The results provided in this work could enhance the knowledge regarding *in situ* detection of Li plating, and its possible application for engineering control systems (i.e. battery management systems, BMS).

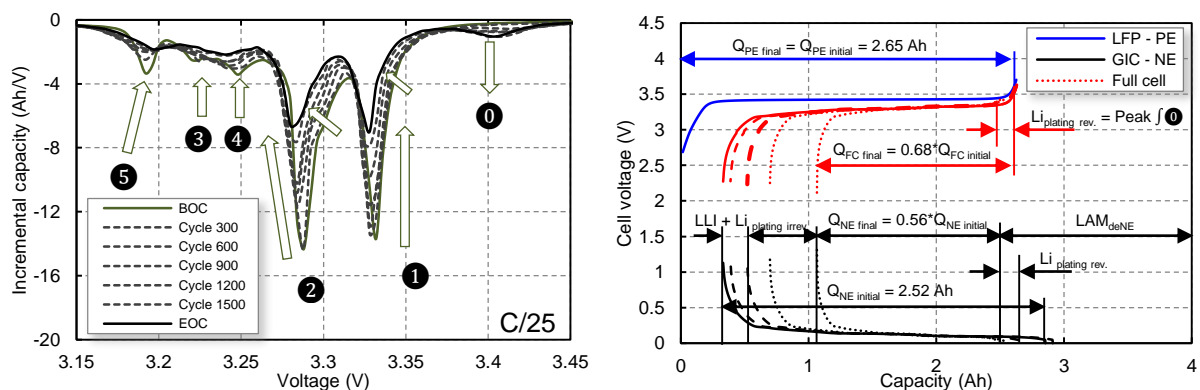


Fig. 1. Results from the GIC||LFP tested cell showing (a) experimental incremental capacity evolution at C/25 and (b) the simulated schematic representation of the evolution with cycling of the individual electrodes

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