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Correlation between electric and mechanical/thermal parameters in a graphite - LiFePO4 Li-ion pouch cel

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The operation of a lithium-ion battery (LIB) cell is governed by the much desirable periodicity and reversibility of lithium ions extraction and insertion mechanisms, as they are transported between the electrodes, keeping the capacity retention high. Unavoidably, there is an irreversible part manifested as capacity loss due to solid electrolyte interphase (SEI) growth, contact loss, active material deterioration, and lithium inventory loss, factors that are extensively documented and studied, mainly through the electric parameters of current, voltage, and charge from cell level to commercial operating battery packs [1]. The significance of monitoring volume changes in LIB stacks, accompanied by a corresponding stress development, is primordial in order to understand the phenomena that lead to degradation and performance decline.

Towards this direction, the correlation of thermodynamic parameters with the commonly studied electric parameters in grahite/LFP lithium-ion battery cells provides important information. From the comparison of stored charge, incremental capacity peak intensity and position and state of health against pressure it can be revealed that there is a strong connection between pressure and peak intensity. The evolution of cell pressure with cycles justifies this relation, however, the cell temperature obeys the joule effect following the current variations. It was found that the normalized pressure varies almost linearly with the State of Charge (SoC) in different parts of the charging curve. This cycle-to-cycle normalized pressure data analysis could potentially be incorporated in a battery management system to provide accurate SoC indications.

Bio : Professor Filippos Farmakis obtained his Bachelor of Science degree in Physics from Aristotle University of Thessaloniki, Greece, in 1996. Subsequently, he earned his Master of Science degree in Optics, Optoelectronics, and Microwaves from National Polytechnic School of Grenoble, France, in 1997. In 2000, he obtained his Doctor of Philosophy degree from the same institution. Following his professional pursuits, Professor Farmakis joined UNAXIS SA, located in Palaiseau, France, as a Process Engineer. He later held the position of R&D Team Leader and specialized in thin film deposition on PECVD production systems for the Displays industry. In 2006, he returned to Greece and engaged in research on chemical sensing field-effects devices and thin film transistors at IMEL, National and Technical Research Center Democritus in Athens. In 2008, he was appointed Head of Technology at Heliosphera SA, a Greek company that manufactures thin film photovoltaic modules in a 60MW manufacturing line.

In July 2012, he joined the Electrical and Computer Engineering Department of Democritus University of Thrace and since 2024, he has assumed the position of Professor. His research interests encompass solar cell technology, thin films, and lithium-ion battery cells. He has authored over 100 publications in refereed journals and conferences and holds three patents. Professor Farmakis is the director of the Micro- and Nanotechnology Lab at Democritus University of Thrace and a co-founder of INEM Technologies p.c., a spin-off company focused on developing lithium-ion batteries for low temperatures. Additionally, he represents Democritus University of Thrace in Battery2030+, a significant initiative aimed at establishing an EU organization responsible for the development of future batteries.