Contribution ID: **150** Type: **Poster**

# Investigation of capacity fade mechanisms and modeling for lithium ion batteries cycled under different state of charge ranges

*Wednesday, 11 December 2019 15:40 (20 minutes)*

Regarding to that lithium-ion batteries are seldom used at the entire state of charge (SoC) interval for the vehicular usage conditions, investigating the battery fatigue mechanisms at different using SoC ranges could guide the battery management. 18650-type cells are cycled at various SoC intervals. In situ methods, e.g. differential voltage analysis (dV/dQ), neutron power diffraction (NPD), electrochemical impedance spectroscopy (EIS), are used to study the battery degradation mechanisms. The results indicate that high SoC range cycling (95%-75%, etc.) shows faster capacity degradation rates, low SoC range cycling (45%-5%, etc.) is more likely to have fatigue inconsistency and trigger the capacity drop. Cathode loss, anode loss, and loss of lithium ions are identified by dV/dQ for all cells at the end of life (700 cycles). The high SoC range cycling cells are investigated by NPD, and crystal structure parameters are observed. Two phases (NCA and NCM) in the cathode are identified, and the NCA is deemed to the main cathode loss by comparing their unit volume changes. EIS is employed to study the inconsistency of capacity fade at same cycling condition, indicating that the capacity fade dispersion deviation is mainly caused by accelerated lithium ion loss along with the ohmic resistance and solid electrolyte interphase resistance increase. At last, an empirical capacity fade modeling which is functional of SoC intervals and equivalent full cycles is proposed and verified.

**Primary authors:** ZHU, Jiangong; KNAPP, Michael (KIT, IAM-ESS); HEERE, Michael; SØRENSEN, Daniel (MLZ); Prof. DAI, Haifeng (Tongji University); Prof. WEI, Xuezhe (Tongji University); EHRENBERG, Helmut (KIT)

**Presenter:** ZHU, Jiangong

**Session Classification:** Poster session

**Track Classification:** Structure Research