



Contribution ID: 105

Type: **Oral contribution**

Investigating surface sensitivity of Ni-rich cathode material towards CO₂ and H₂O

Thursday 8 December 2022 14:00 (20 minutes)

Layered Ni-rich transition metal oxide materials have been considered as the most promising cathode utilized in Li-ion batteries, e.g., LiNi_{0.8}Mn_{0.1}Co_{0.1}O₂ (NMC 811). However, one of the drawbacks of NMC 811 is its high air sensitivity, leading to a degradation layer forming on the surface, and a lower cycling performance.[1] Since the degradation mechanism is not fully understood, in this work, we use ambient pressure photoelectron spectroscopy (APPEs) [2] to investigate the surface sensitivity of NMC 811 towards CO₂ and H₂O in situ, aiming to determine the factor triggering the degradation. Before gas exposure, NMC 811 surface was studied in UHV. The changes in surface chemical composition were monitored as a function of time and gas pressure. Results show that carbonate compounds will form on the surface when NMC 811 is exposed to CO₂ at around 10⁻³ mbar and start to disappear in UHV after CO₂ exposure. More interestingly, the photon beam can accelerate the formation of carbonate on NMC particles surface. The same measurements were finished with H₂O exposure as well. Results indicate that lithium hydroxide is formed, where active surface oxygen can be the possible explanation.[3] However, this reaction is reversible in UHV as well.

References

- [[1] R. Jung et al., "Effect of Ambient Storage on the Degradation of Ni-Rich Positive Electrode Materials (NMC811) for Li-Ion Batteries," Journal of The Electrochemical Society, vol. 165, no. 2, pp. A132-A141, 2018, doi: 10.1149/2.0401802jes.
- [2] E. Kokkonen et al., "Upgrade of the SPECIES beamline at the MAX IV Laboratory," Journal of Synchrotron Radiation, vol. 28, no. 2, pp. 588-601, 2021-03-01 2021, doi: 10.1107/s1600577521000564.
- [3] M. Yoon et al., "Reactive boride infusion stabilizes Ni-rich cathodes for lithium-ion batteries," Nature Energy, vol. 6, no. 4, pp. 362-371, 2021-04-01 2021, doi: 10.1038/s41560-021-00782-0.

if "Other", please specify:

I apply for a travel grant

No

Author: CHEN, Heyin (Uppsala University)

Co-authors: EADS, Calley (MAX IV Laboratory); TEMPERTON, Robert (MAX IV Laboratory); KOKKONEN, Esko (MAX IV Laboratory); Dr BRANT, William (Uppsala University); Dr KÄLLQUIST, Ida (Uppsala university); Dr ERICSON, Tove (Uppsala University); Ms MIKHEENKOVA, Anastasiia (Uppsala University); Dr HAHLIN, Maria (Uppsala University)

Presenter: CHEN, Heyin (Uppsala University)

Track Classification: Surface science/chemistry