



## Analysis of the Interphase on Carbon Black Formed in High Voltage Batteries

Younesi, Reza; Christiansen, Ane Sælland; Scipioni, Roberto; Ngo, Duc-The; Simonsen, Søren Bredmose; Edström, Kristina; Hjelm, Johan; Norby, Poul

*Publication date:*  
2015

*Document Version*  
Peer reviewed version

[Link back to DTU Orbit](#)

*Citation (APA):*  
Younesi, R., Christiansen, A. S., Scipioni, R., Ngo, D-T., Simonsen, S. B., Edström, K., Hjelm, J., & Norby, P. (2015). *Analysis of the Interphase on Carbon Black Formed in High Voltage Batteries*. Abstract from Nordic Battery Conference 2015, Trondheim, Norway.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## Analysis of the Interphase on Carbon Black Formed in High Voltage Batteries

Reza Younesi<sup>2</sup>, Ane Sælland Christiansen<sup>1</sup>, Roberto Scipioni<sup>1</sup>, Duc-The Ngo<sup>1</sup>,  
Søren Bredmose Simonsen<sup>1</sup>, Kristina Edström<sup>2</sup>, Johan Hjelm<sup>1</sup> and Poul Norby<sup>1</sup>.

<sup>1</sup> Department of Energy Conversion and Storage, Technical University of Denmark, DK-4000 Roskilde, Denmark - asach@dtu.dk

<sup>2</sup> Department of Chemistry, Ångström Laboratory, Uppsala University, SE-751 21 Uppsala, Sweden

Carbon black (CB) additives commonly used to increase the electrical conductivity of electrodes in Li-ion batteries are generally believed to be electrochemically inert additives in cathodes. Decomposition of electrolyte in the surface region of CB in Li-ion cells at high voltages up to 4.9 V is here studied using electrochemical measurements as well as structural and surface characterizations.  $\text{LiPF}_6$  and  $\text{LiClO}_4$  dissolved in ethylene carbonate:diethylene carbonate (1:1) were used as the electrolyte to study irreversible charge capacity of CB cathodes when cycled between 4.9 V and 2.5 V. Synchrotron-based soft X-ray photoelectron spectroscopy (SOXPES) results revealed spontaneous partial decomposition of the electrolytes on the CB electrode, without applying external current or voltage. Depth profile analysis of the electrolyte/cathode interphase indicated that the concentration of decomposed species is highest at the outermost surface of the CB. It is concluded that carboxylate and carbonate bonds (originating from solvent decomposition) and LiF (when  $\text{LiPF}_6$  was used) take part in the formation of the decomposed species. Electrochemical impedance spectroscopy measurements and transmission electron microscopy results, however, did not show formation of a dense surface layer on CB particles.

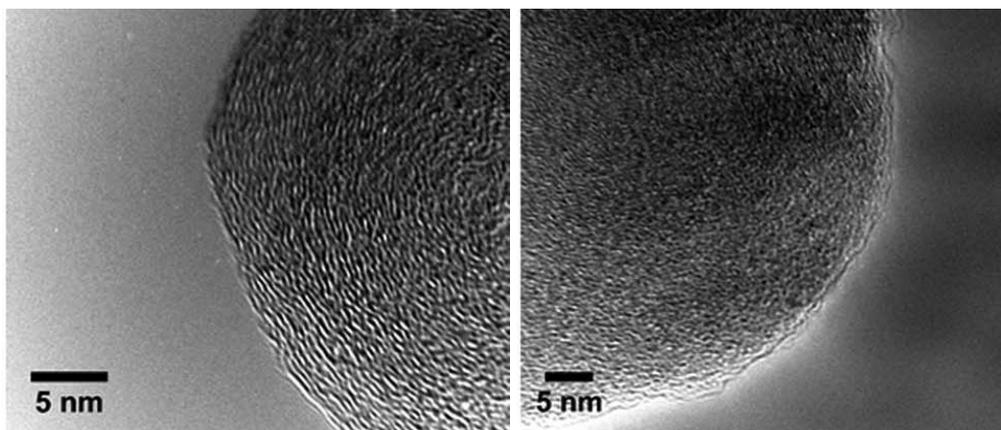


Figure 1: High-resolution TEM images of pristine (left) carbon black particles and after charge to 5.2 V (right).