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UNIVERSITY OF TECHNOLOGY

COMSOL CONFERENCE 2016 MUNICH

Effect Of Intercalation Diffusivity When Simulating Mixed Electrode Materials In Li-Ion Batteries

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Outline

- Background
- Physics based modeling
- Mixed electrode material
- Results
- Conclusions

Photo: Volvo

Background

Volvo Cars Corporation
Battery Systems
Theresa Granérus
Henrik Markusson

ABB AB
Corporate Research
Tomas Tengnér
Antonis Marinopoulos

Uppsala University
Ångström Advanced Battery Center
Prof. Kristina Edström
Prof. Daniel Brandell
Erik Björklund

Chalmers University of Technology
Electric Power Engineering
Prof. Torbjörn Thiringer
Evelina Wikner

PhD project

- Aging mechanisms
- Simulation of chosen mechanisms
- Predict aging
- Improve battery utilization

Funded by:

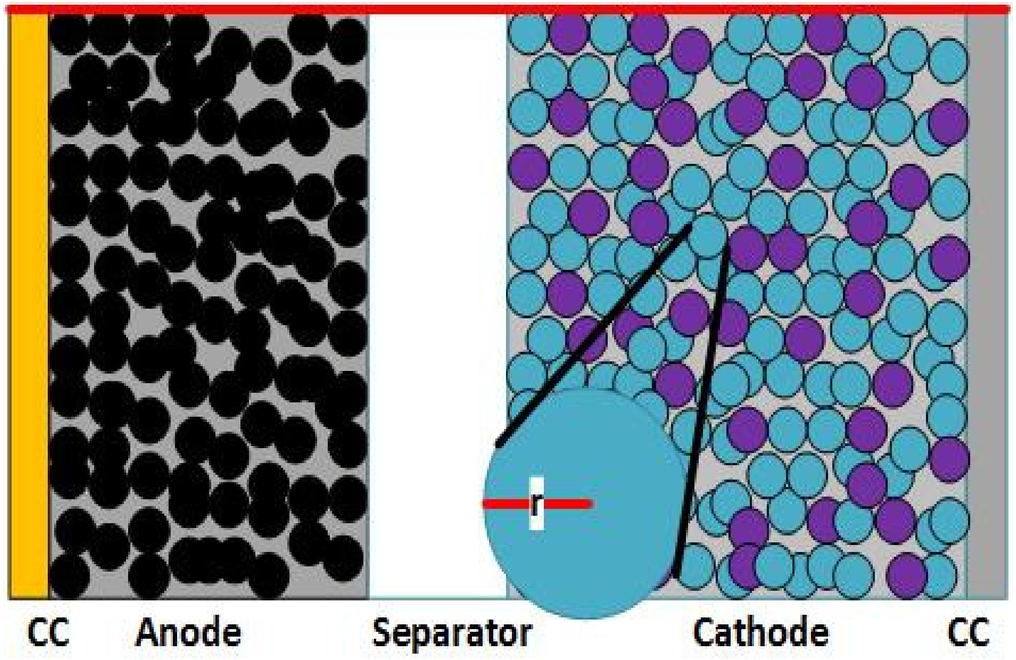
Swedish Energy Agency

VOLVO

ABB

Physics based battery model

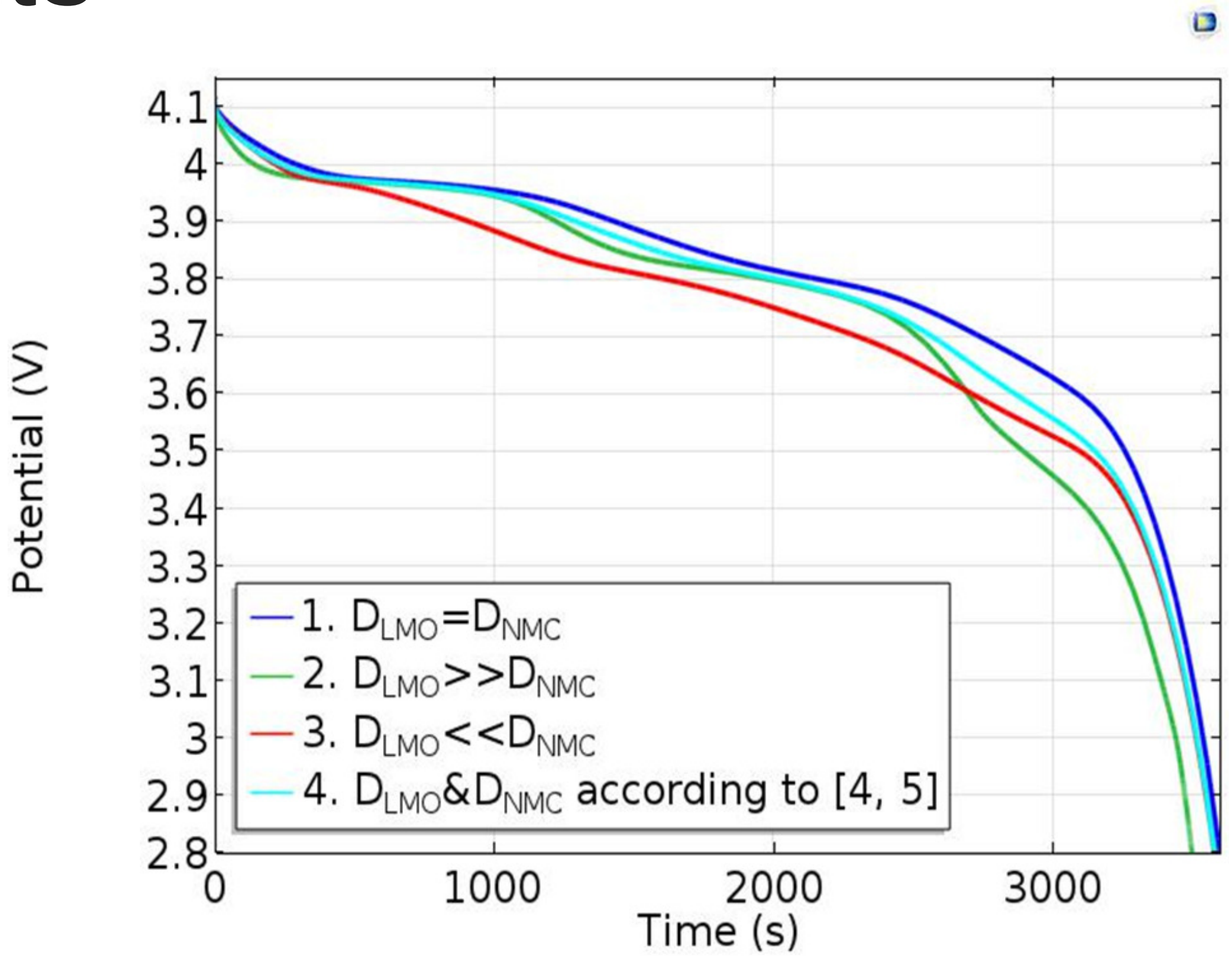
- More then 80 parameters!
- Difficult to measure several of the parameters
- Concentration and temperature dependence



Mixed electrode materials

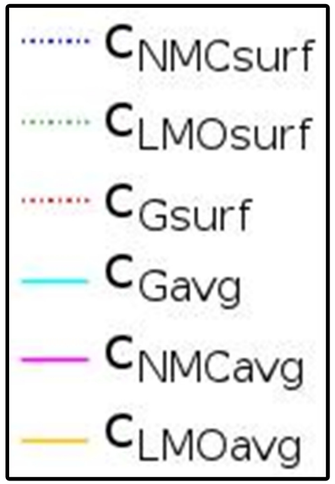
- Higher complexity
- More parameters
- Higher impact of diffusion coefficient

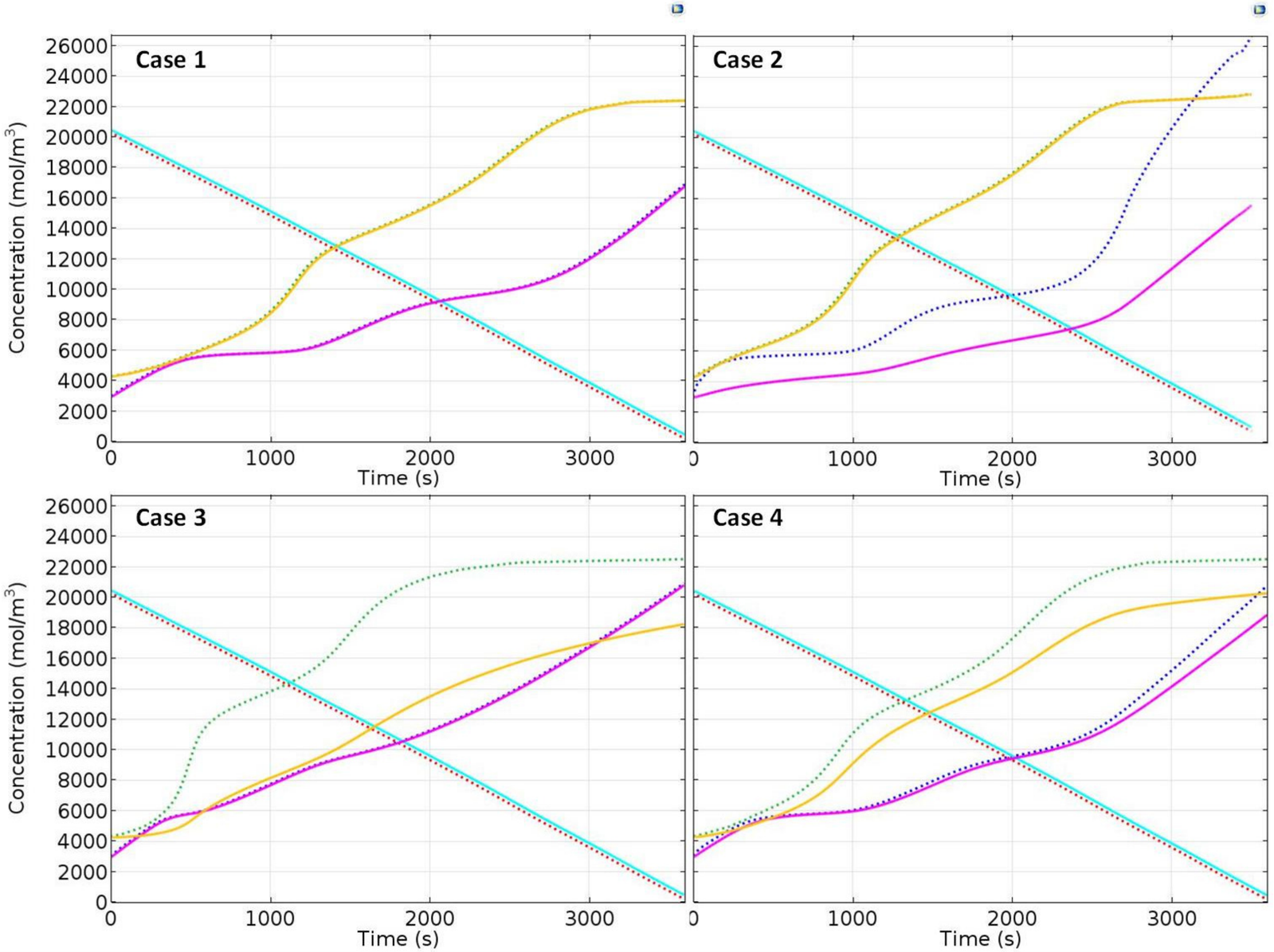
Results



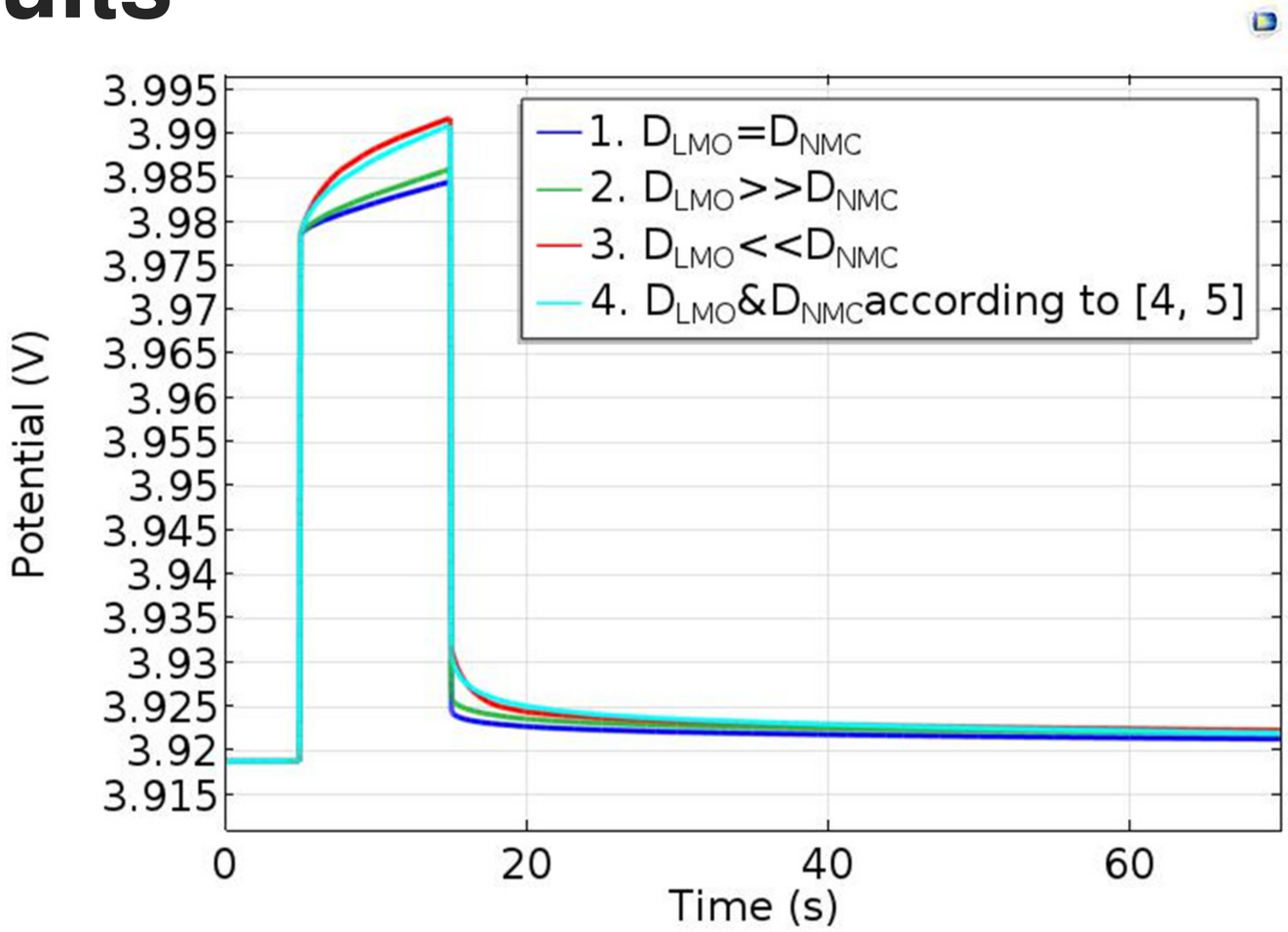
4. P. C. Goonetilleke, J. P. Zheng and D. Roy, “Effects of Surface-Film Formation on the Electrochemical Characteristics of LiMn2O4 Cathodes of Lithium Ion Batteries”, *Journal of the Electrochemical Society*, **vol. 156**, pp. A709-A719 (2009)
5. Wu, Shao-Ling, Wei Zhang, Xiangyun Song, Alpesh K. Shukla, Gao Liu, Vincent S. Battaglia, and Venkat Srinivasan, High Rate Capability of Li(Ni1/3Mn1/3Co1/3)O2 Electrode for Li-Ion Batteries, *Journal of the Electrochemical Society*, **vol. 159** , pp. A438-A444 (2012)

Results


$c_{NMCsurf}$
$c_{LMOsurf}$
c_{Gsurf}
c_{Gavg}
c_{NMCavg}
c_{LMOavg}


Case 1
Case 2
Case 3
Case 4
Concentration (mol/m^3)
Time (s)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
1000
2000
3000

Results



4. P. C. Goonetilleke, J. P. Zheng and D. Roy, “Effects of Surface-Film Formation on the Electrochemical Characteristics of LiMn2O4 Cathodes of Lithium Ion Batteries”, *Journal of the Electrochemical Society*, **vol. 156**, pp. A709-A719 (2009)
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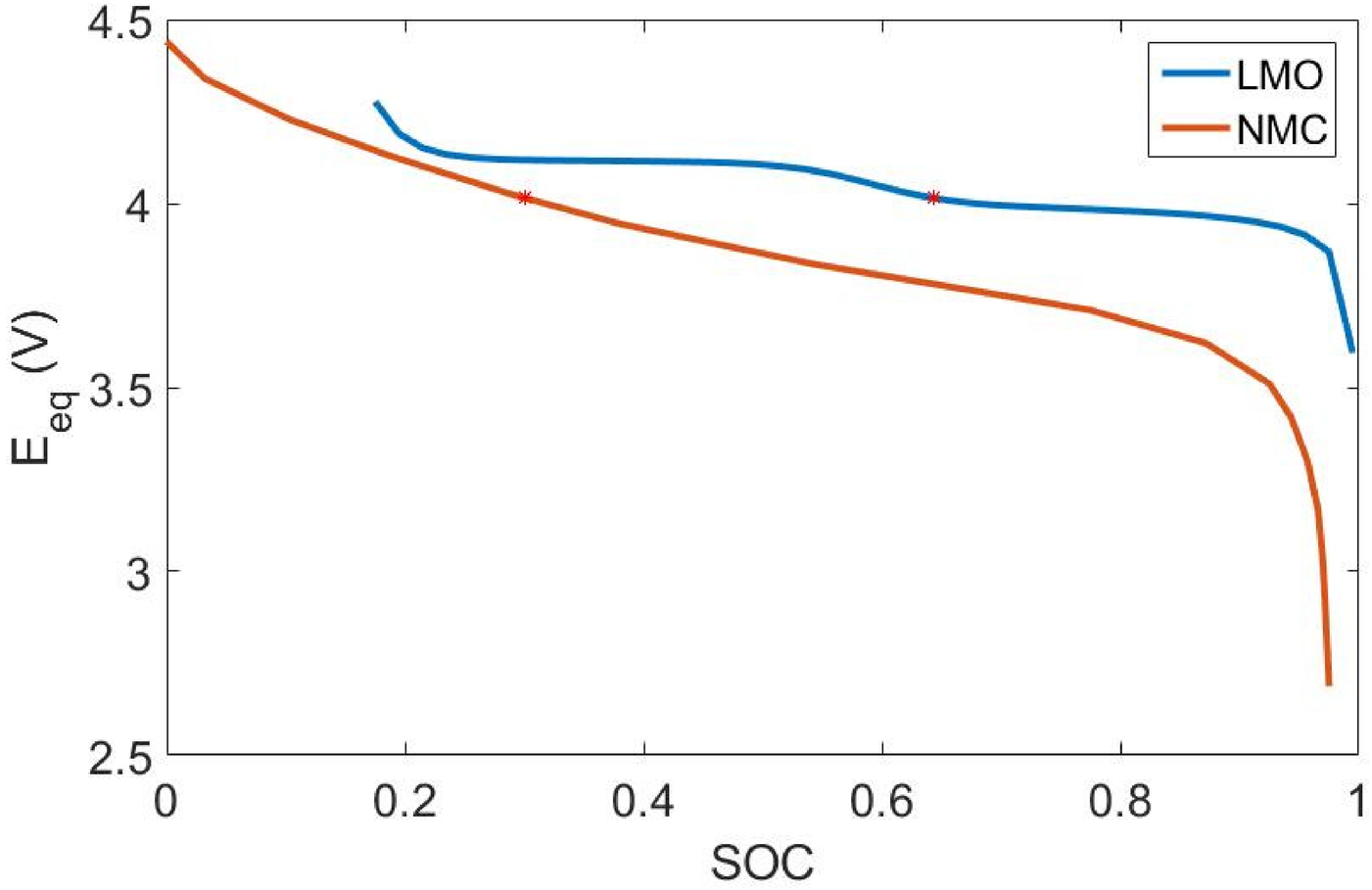
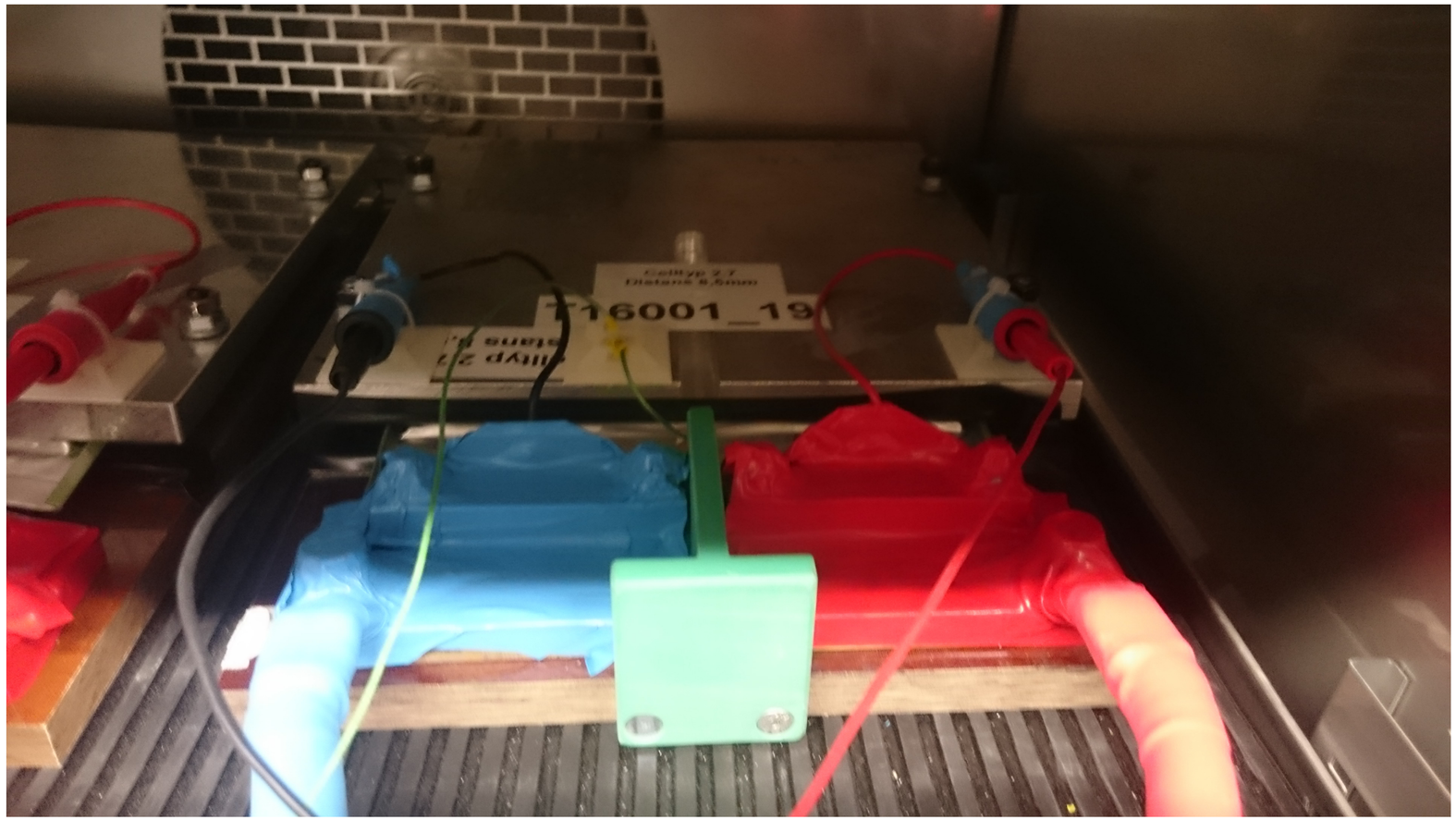
Results



Conclusions

- Special care needs to be taken when simulating mixed electrode materials.
- The diffusion coefficient's concentration dependence should not be neglected.
- The model can be used to find optimal mix of two electrode materials.

Thank you for your attention!



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