

ALBA 2026 Webinar:

Voltage plateau experimental findings

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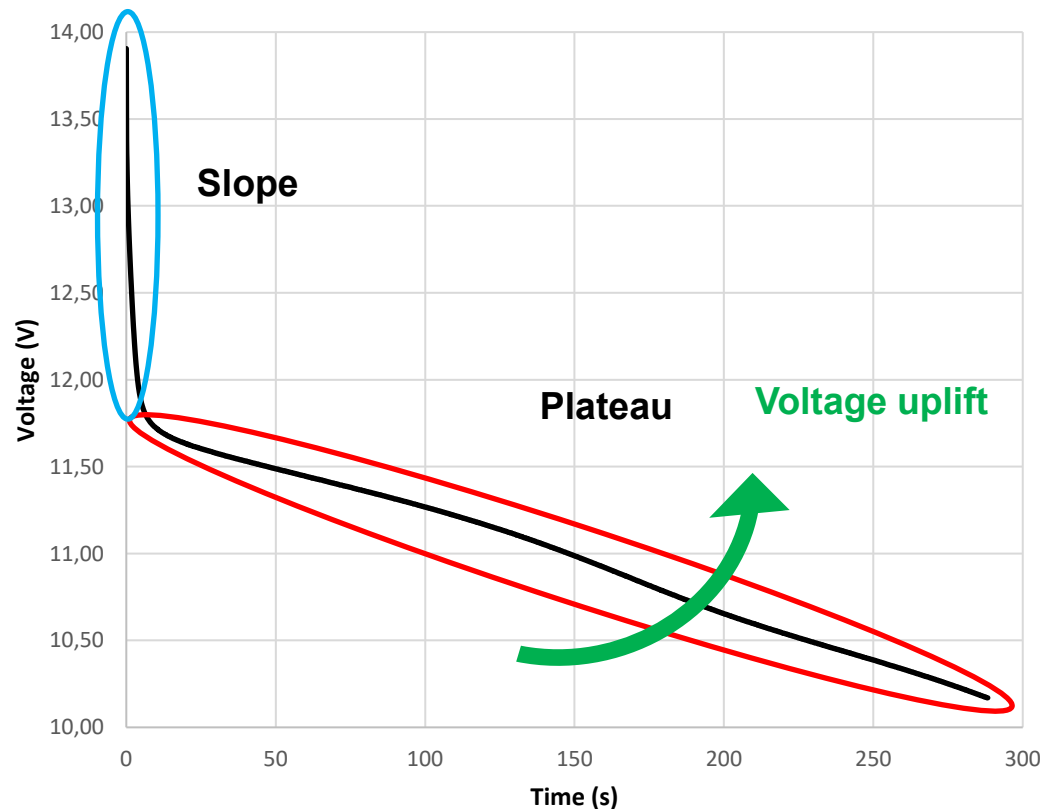
AGENDA

- Definition and hypothesis
- Experimental results: Review of CR group findings
- Conclusions



Voltage plateau:

SoF



- In a discharge curve we can easily distinguish two different zones, one related to pseudocapacitance and double layer effects that we called “slope” and another one related to the later voltage plateau
- The voltage plateau is a larger area and more stable in time which is very important for predictions in safety operations
- The objective is to increase and stabilize the voltage plateau by
 - Charging strategies
 - Additives
 - Design

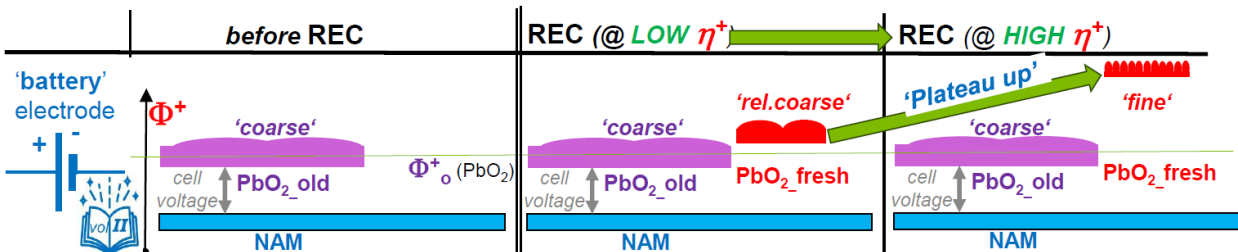


Voltage plateau experimental findings: Hypothesis

CR 11: Understanding PbO₂ structure: fast SoF recovery @ PSoC Dr. Eberhard Meissner

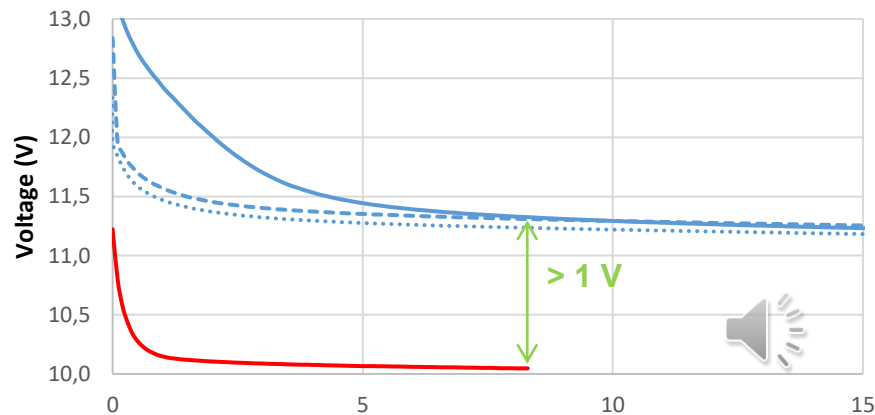
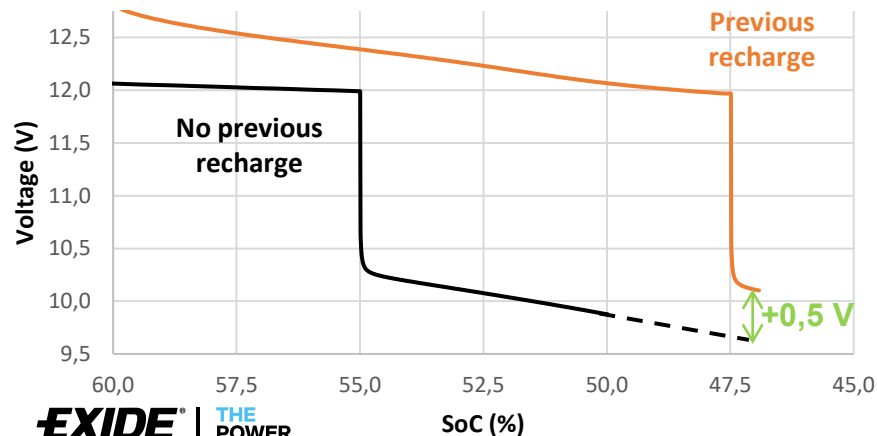
CR: PbO₂ Structure and SoF Recovery: bottom-up analysis and hypotheses

C.I + C.II Mechanisms behind 'uplift of discharge Plateau' + 'pseudo-capacitance' Slope
high positive polarization η^+ [V] is good for both 'Plateau uplift' and 'Slope'



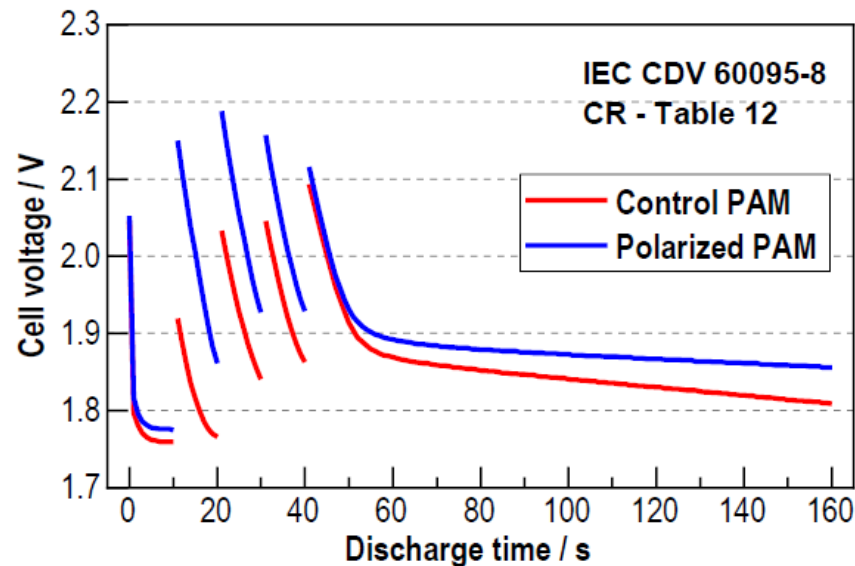
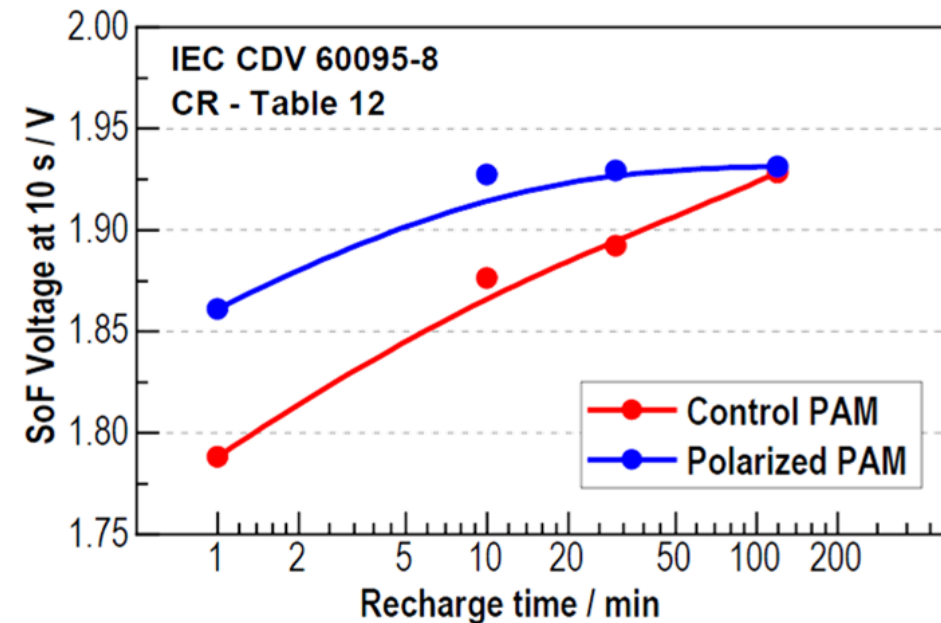
There are many different examples where we can observe a voltage uplift from a baseline discharge without a recent charge

We have observed that the new voltage plateau is stable but with a positive ΔV that is translated into a better SoF that can be used for safety functions



Voltage plateau experimental findings: Charging strategy

CR18: Impact of PAM Charge Potential, SoC Recovery Levels and Relaxation Time on SoF Performance During Charge Recovery Testing. Dr Plamen Nikolov



- Elevated PAM polarization during CR charging results to considerable shift of SoF absolute voltage values and relative voltage uplift to unusually higher values.
- The impact of PAM polarization is very strong for charging times less than 30 min while above 30 min the influence of PAM polarization disappears

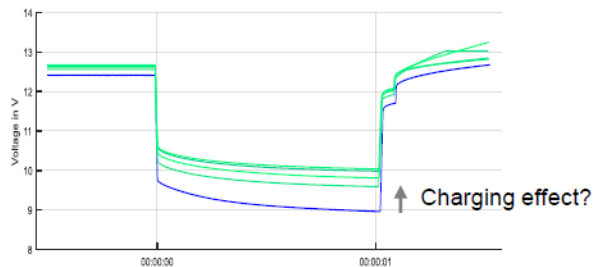
- The PAM potential response during SoF fully determines the cell voltage.
- Higher PAM potential during charging results to remarkable increase of SoF cell voltage

Voltage plateau experimental findings: Charging strategy and temperature

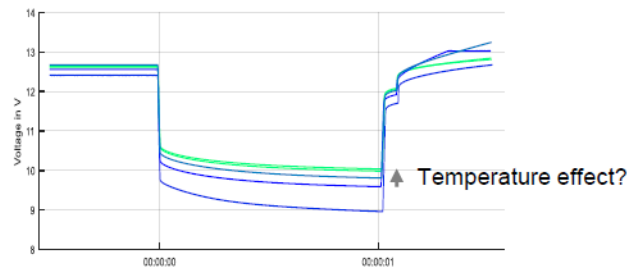
CR15-SOF recovery parameters during simulated driving. Jonathan Wirth

We have observed that the voltage plateau is also influenced by the recharge conditions and the temperature

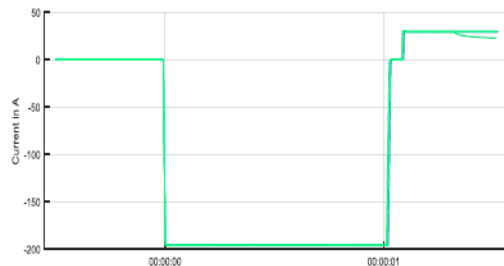
SoC as curve value



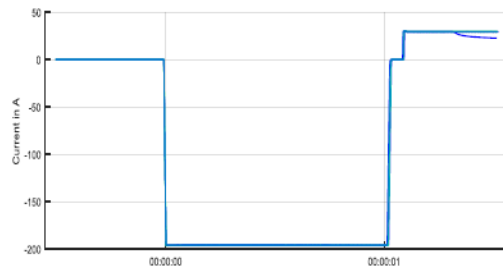
Temperature as curve color



Pulse	SoC	Temp	U _{end,ppc}	U _{end,meas}	ΔU
1	40%	-11 °C	8,97 V	8,96 V	-0,01 V
2	51%	-7 °C	9,37 V	9,98 V	+0,61 V
3	53%	-7 °C	9,41 V	10,04 V	+0,63 V
4	52%	-12 °C	9,15 V	9,59 V	+0,44 V
5	54%	-10 °C	9,29 V	9,72 V	+0,43 V



SoC = 40...54%
(charging from 38%)



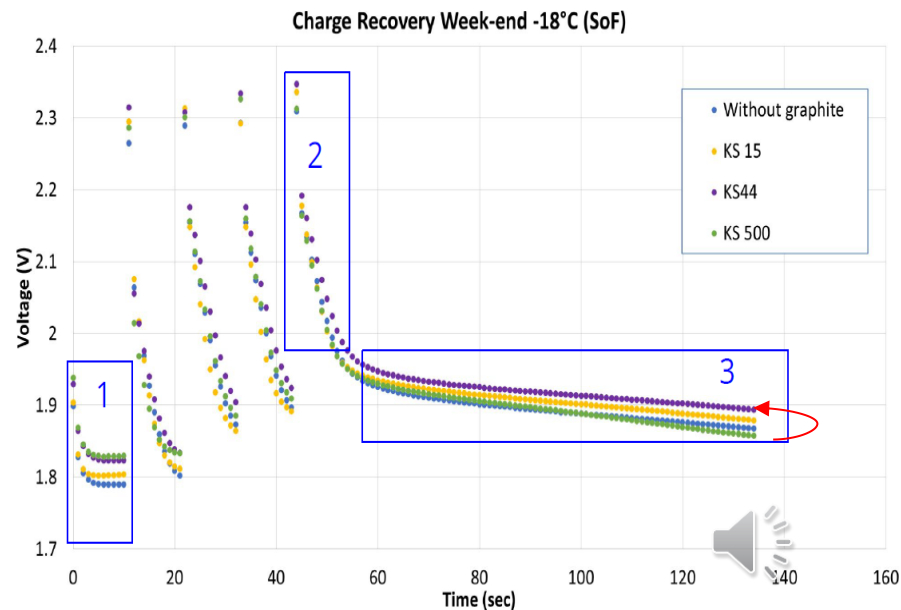
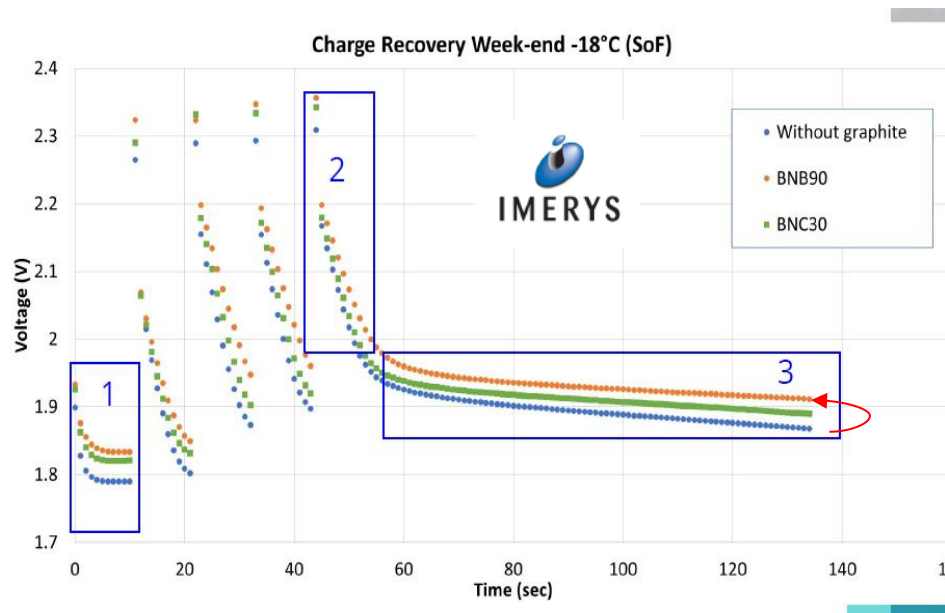
ϑ_{bat} = -12...-7 °C



Voltage plateau experimental findings: Additives in PAM

CR24: Charge recovery in the positive active mass through synthetic and expanded graphite addition. Dr Pascual García

Once we have deep dived in the phenomenon, we can find strategies to modify an increase the charge recovery and voltage increment, like in this case where Imerys found a better performance in the SoF due to the addition of graphite into the PAM



Voltage plateau experimental findings: Additives in NAM

CR25: NAM Recipe Optimization for DCA & CR Variation. Markus Föhlisch

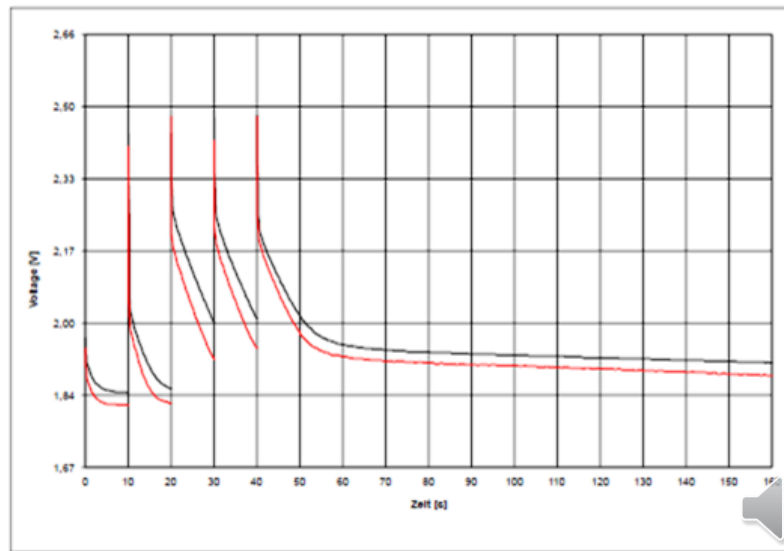
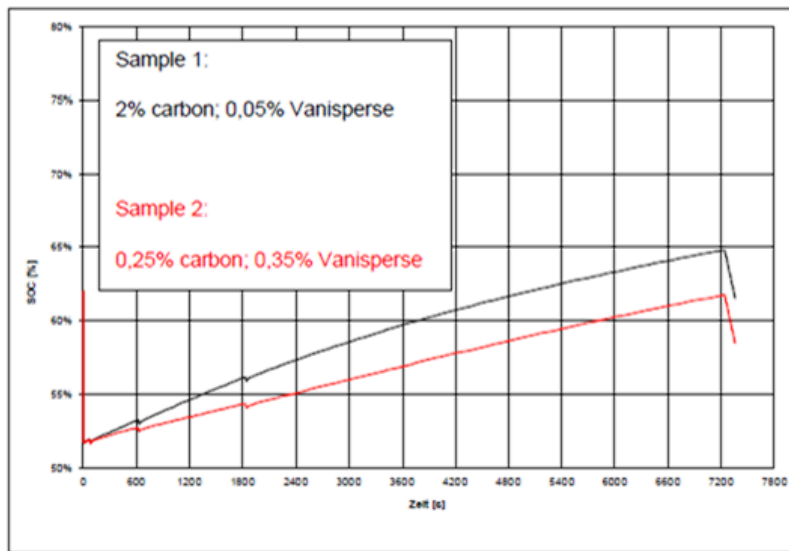
By smart combinations of carbon and expander we can tune charge recovery and influence the later discharge as demonstrated

NAM Recipe Optimization for DCA & CR Variation

Markus Föhlisch



Test Results – MOLL carbon + Vanisperse



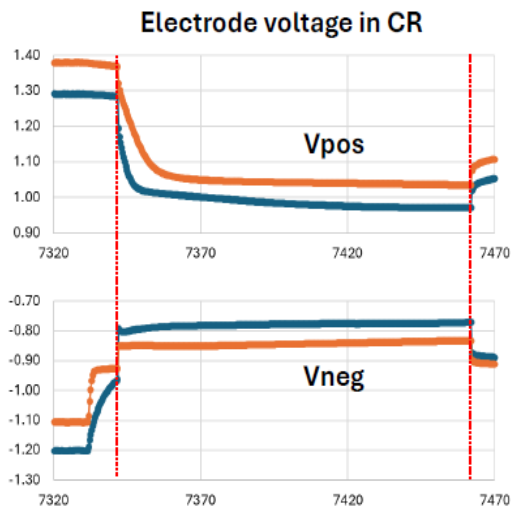
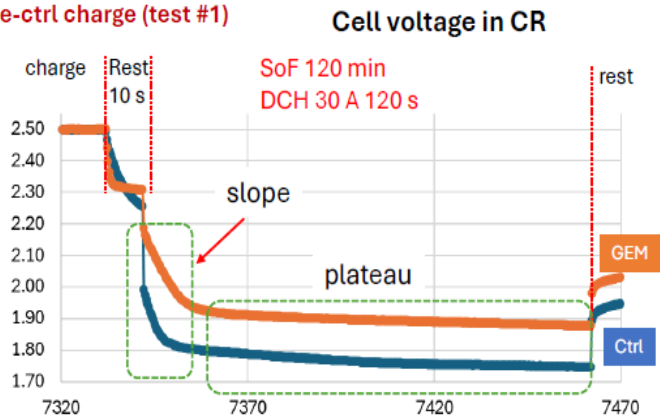
Voltage plateau experimental findings: Design

CR26: Optimizing voltage distribution in Charge Recovery by GEM negative electrodes. Jibo Zhang

30 Ah 2V AGM cell

CR weekend, -18 C

Time-ctrl charge (test #1)



The new developed separator is able to offer and increased SoF behavior by increasing both, the slope and the voltage plateau

Positive polarizations strongly affects the SoF behavior:

1. Capacitor-like slope developed after charge
2. Extra energy ($V > V_{ocv}$) stored in PAM
3. A more energetic PAM for a certain capacity



Conclusions

- Pseudocapacitance is a short-term effect but...
- The voltage plateau uplift stays available longer, and we can boost it by modifying the charging strategy, battery design, additives...
- The plateau uplift is maintained even when drained Ah are higher than the previous recharged and it is stable and predictable
- End voltage is always higher when a previous recharge has been done even at lower SoC





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