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Microstructure modification of the Prussian White cathode material and its effect on the electrochemical performance of sodium-ion batteries

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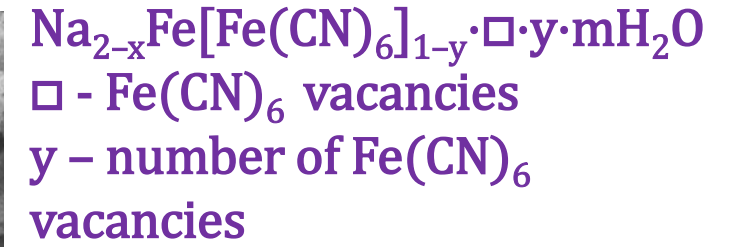
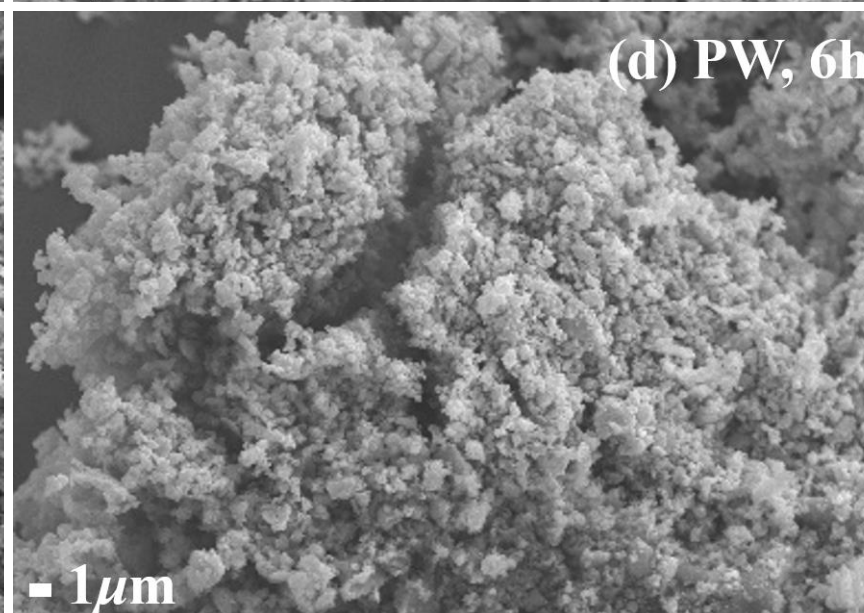
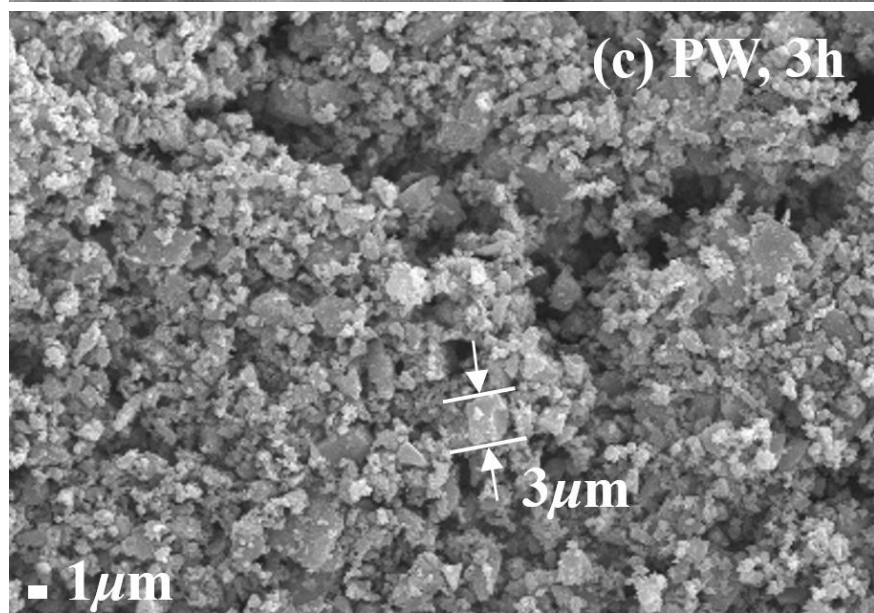
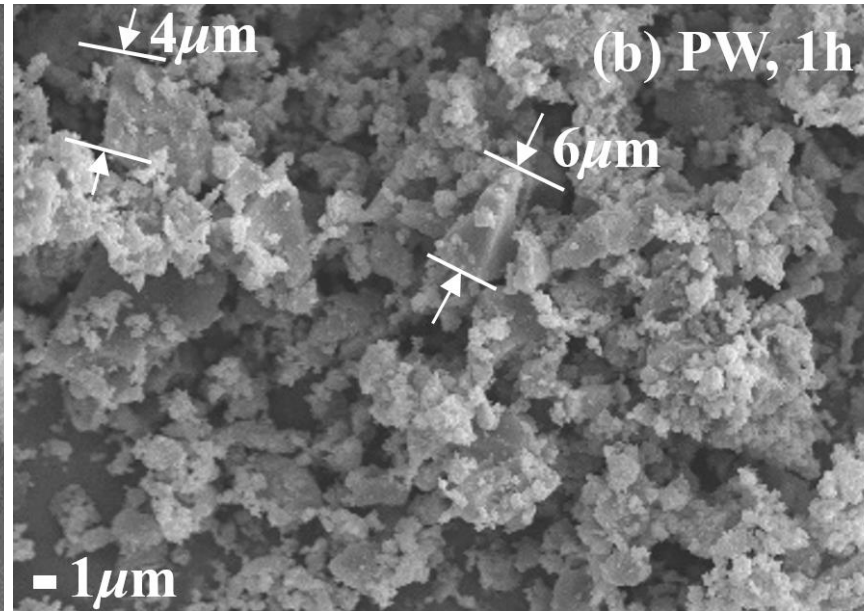
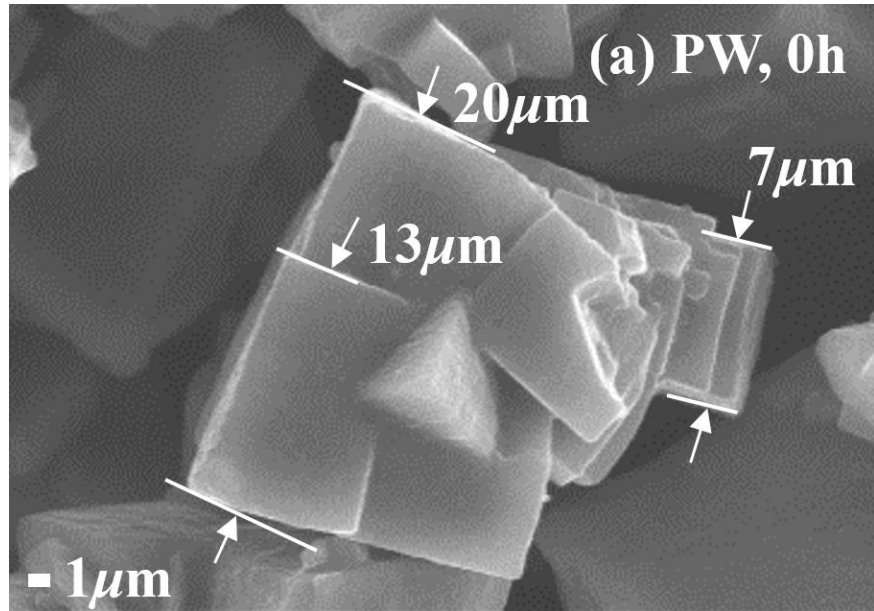
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India-JINR workshop on elementary particle and nuclear physics, and condensed matter research



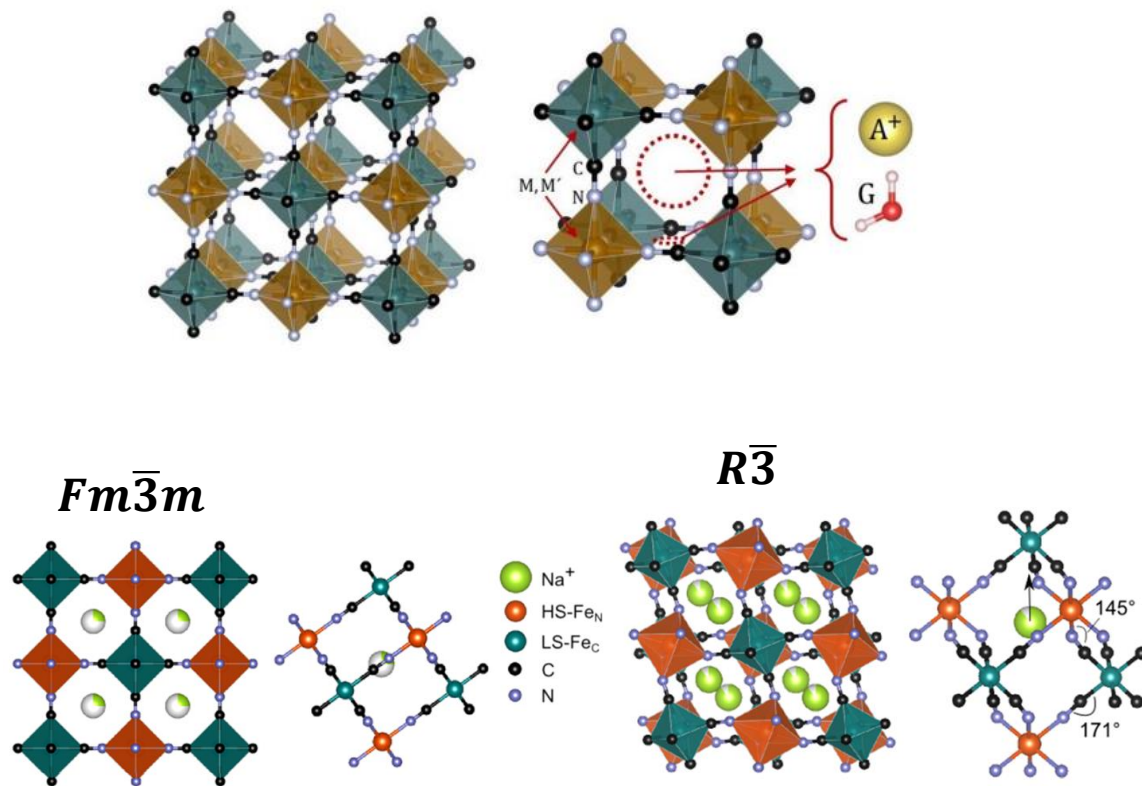
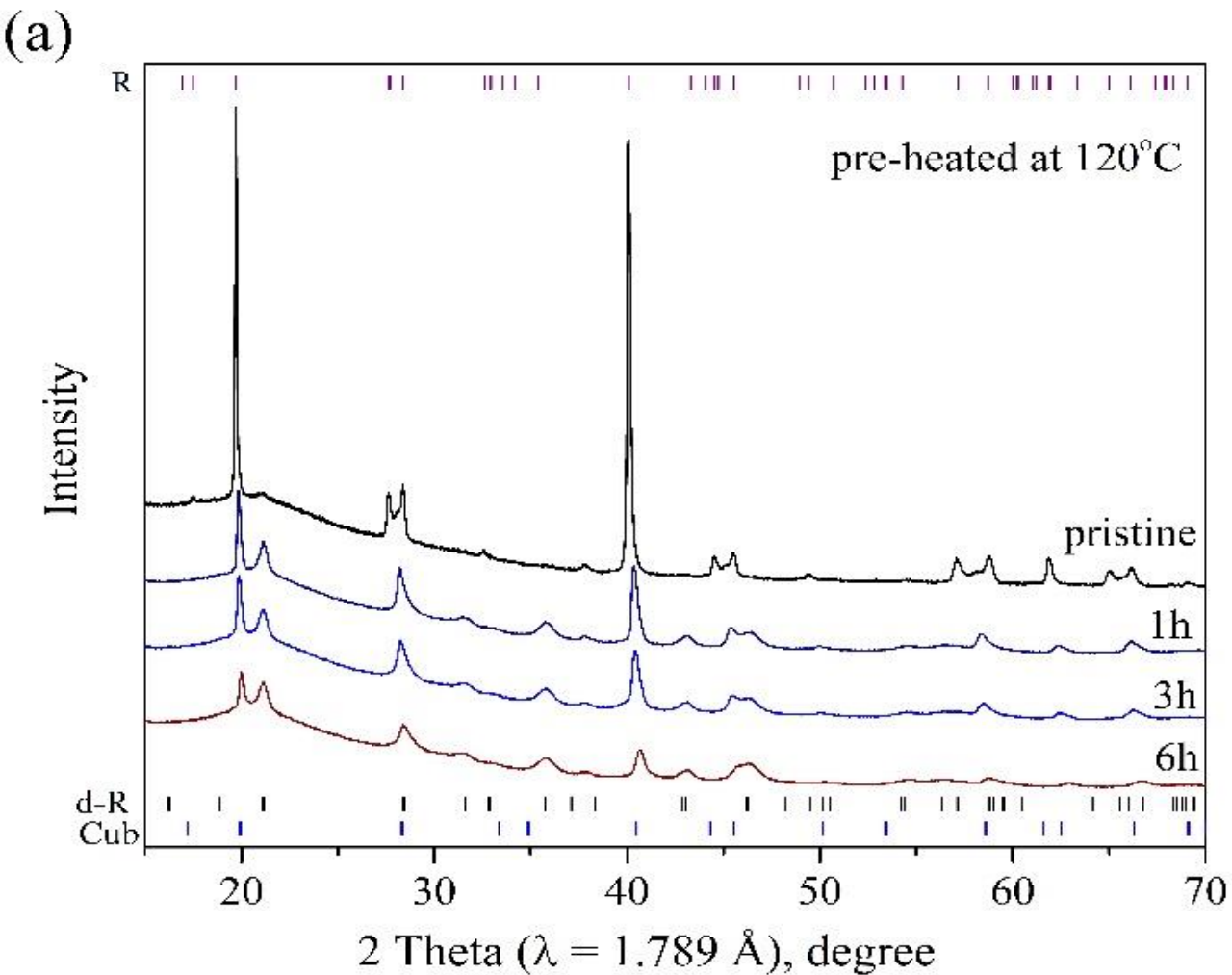
SEM-images of pristine and milled Prussian White samples



- Pristine PW material has cubic morphology.
- Milling program in planetary mill:
1h, 3h and 6h, $\omega=600\text{rpm}$.
- Milling was carried out with acetone to obtain a more homogeneous sample.
- The destruction of cube-shaped particles occurs as milling time increases.

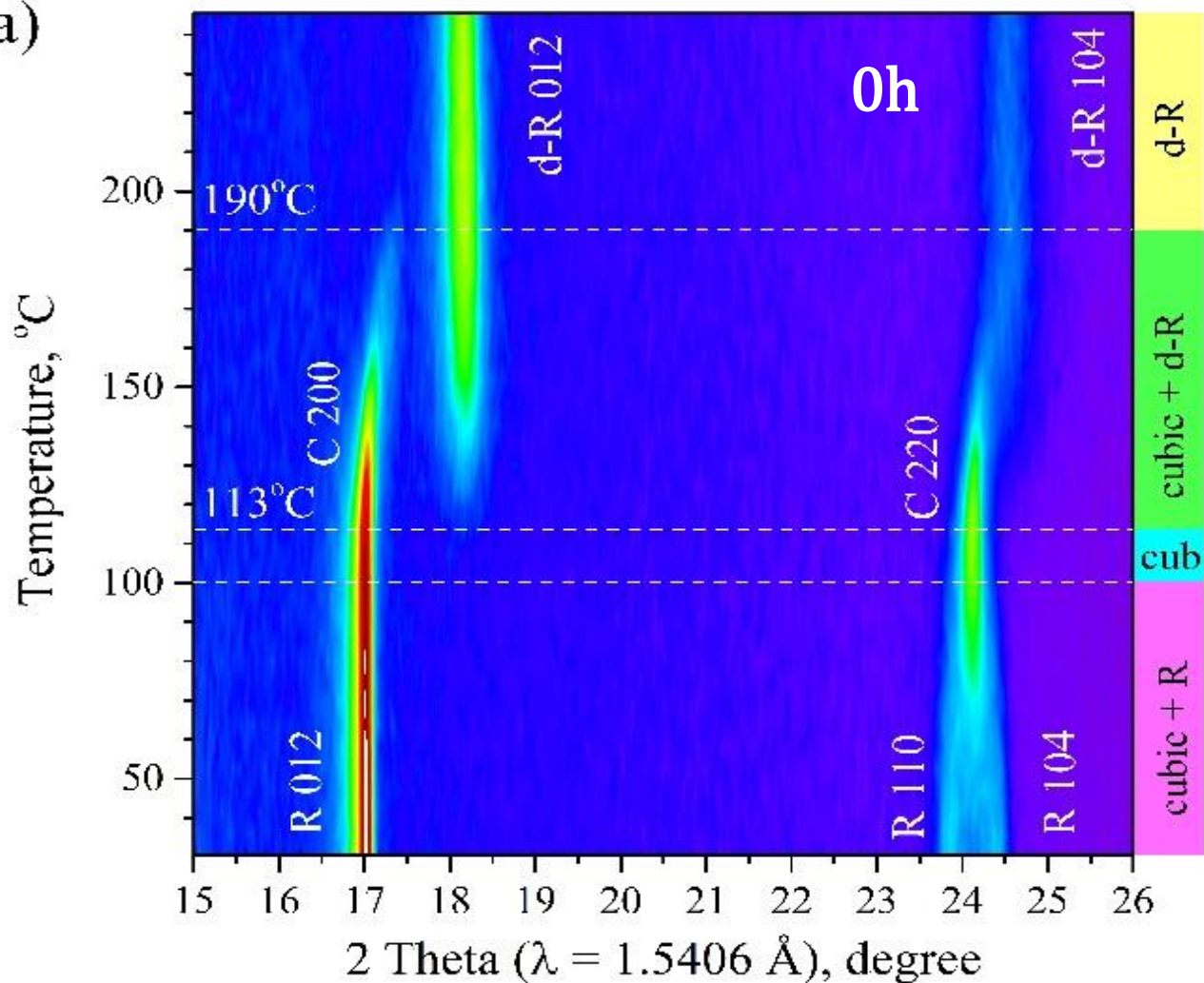


Structural study. XRD spectra of pristine and milled PW samples. Phase analysis.

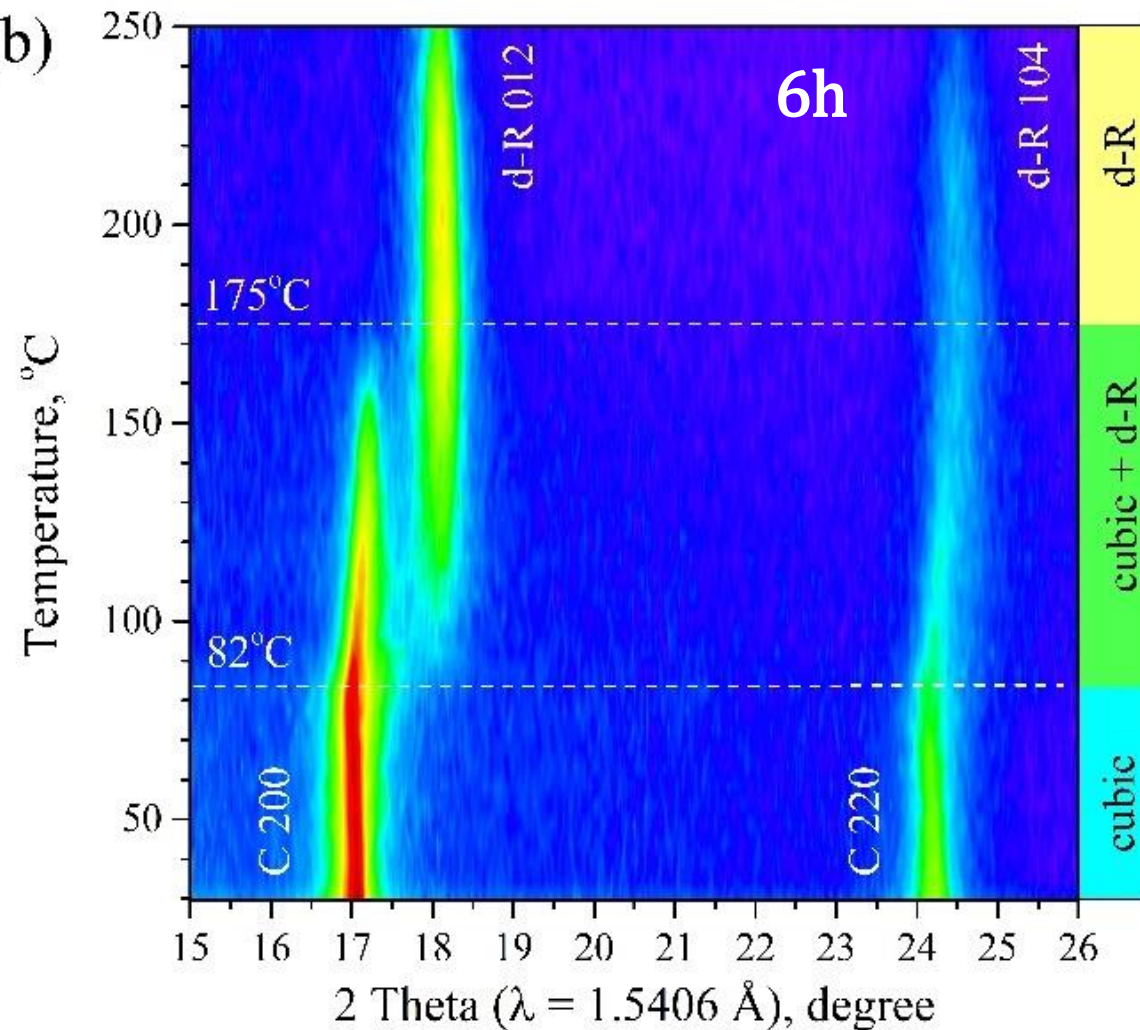


2D evolution of XRD patterns from the pristine PW and 6h-milled PW powders during heating up to 250°C in vacuum

(a)



(b)





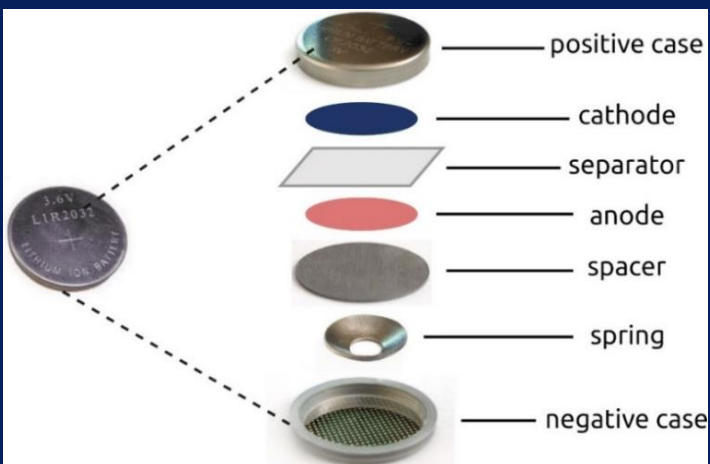
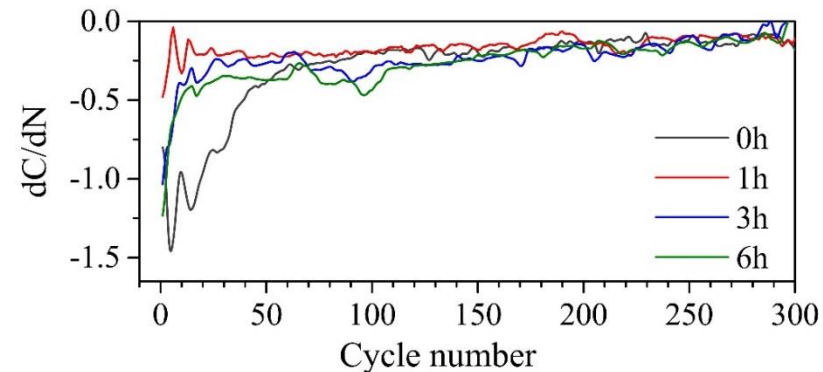
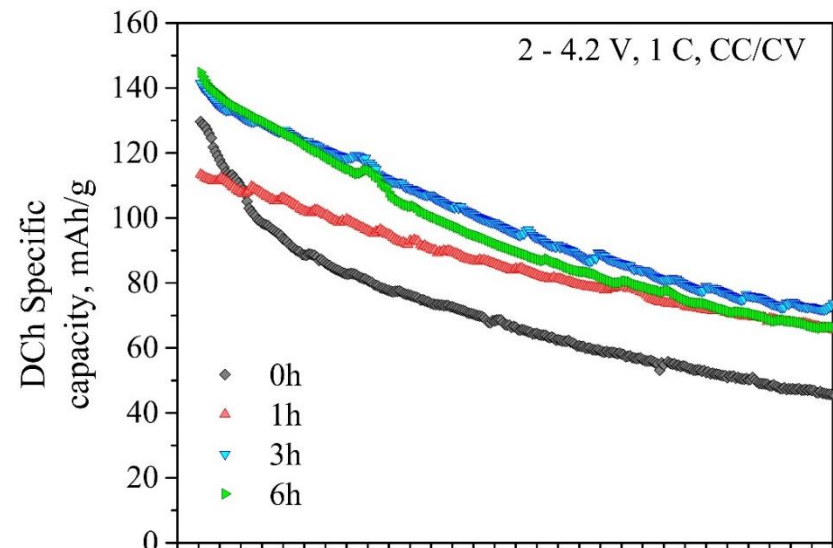
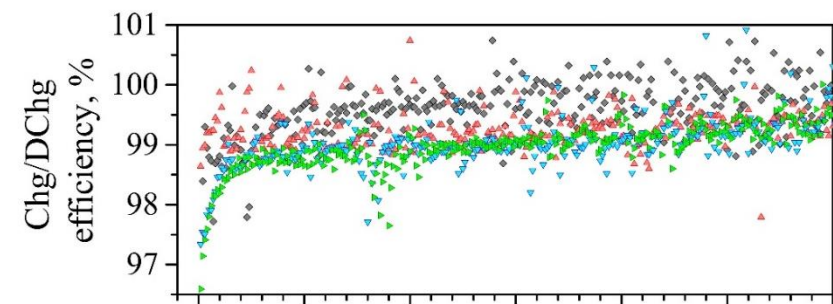
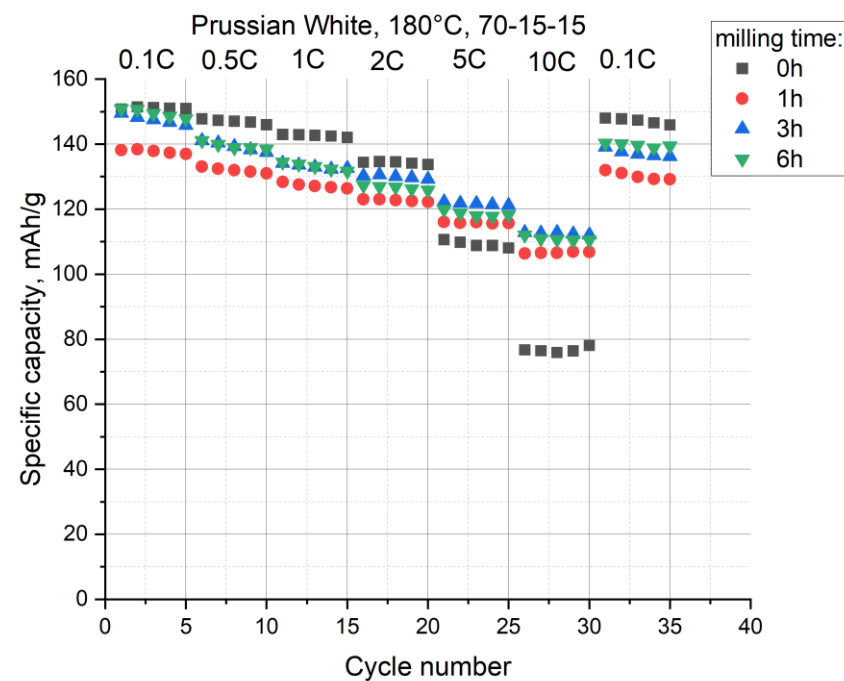
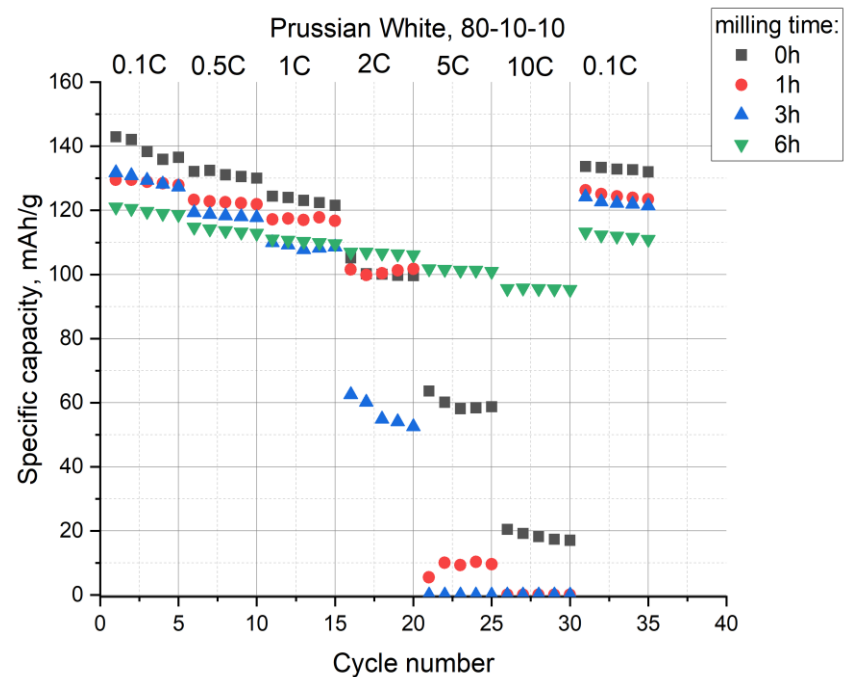
Electrochemical study

PW/KetjenBlack/PVDF:

(a)– 70/15/15

(b)– 80/10/10

(c)– 70/15/15



Results and conclusions

1. The original PW contains several structural phases:
rhombohedral phase (“R”) ~ 55%
cubic phase ~40%
small amount of another rhombohedral phase (dehydrated “d-R”) ~ 4%
2. d-R phase fraction: $\left\{ \begin{array}{l} \approx 52\% \text{ for 1h and 3h of milling} \\ \approx 65\% \text{ for 6h of milling} \end{array} \right.$
3. As a result of the release of water from the structure, the cubic phase transforms into the dehydrated rhombohedral phase.
4. The initial capacity of an electrode based on PW 0h at a rate of 0.1C is 150 mAh/g, compared to a theoretical capacity of 170.8 mAh/g.
5. 0.1C – 2C: electrodes based on milled PW powders show a capacity slightly lower than the capacity of the original, irregularly depending on the grinding time.
5C, 10C: milled PW electrodes show a consistently higher capacity compared to the original PW electrode - the longer the milling time, the higher the capacity.



Thank you for your kind attention!

