

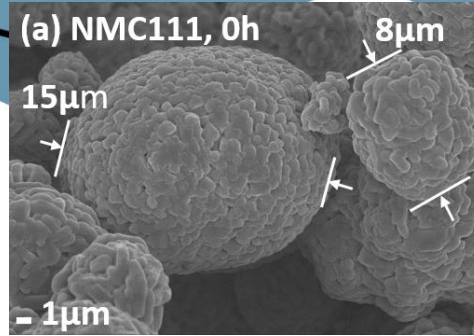
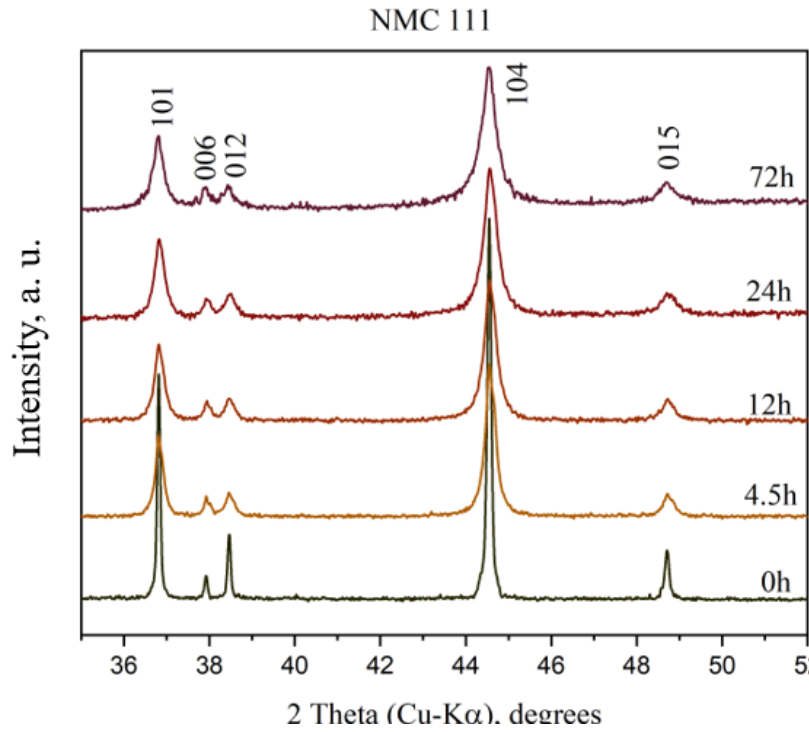


Ball Milling Treatment Effects on the Electrochemical Capacity of the $\text{P2-Na}_{0.7}\text{MnO}_2$ cathode material

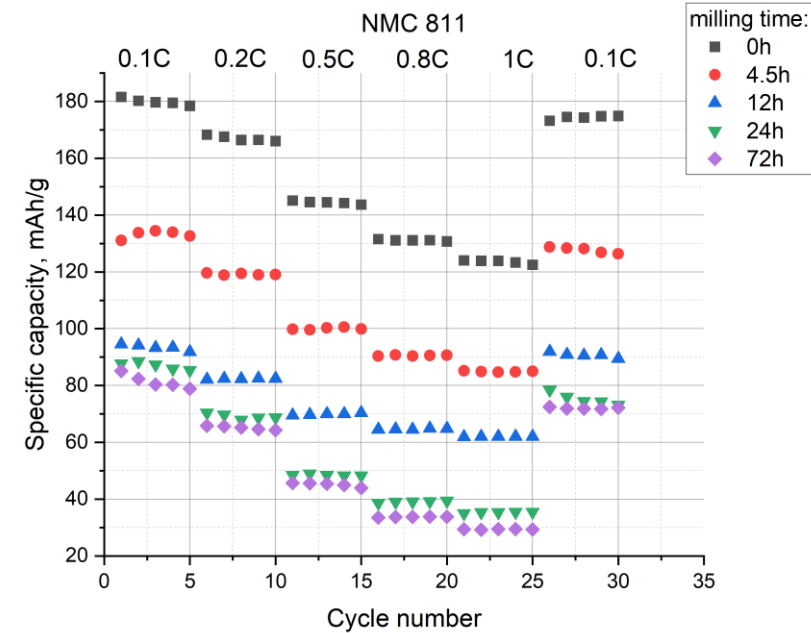
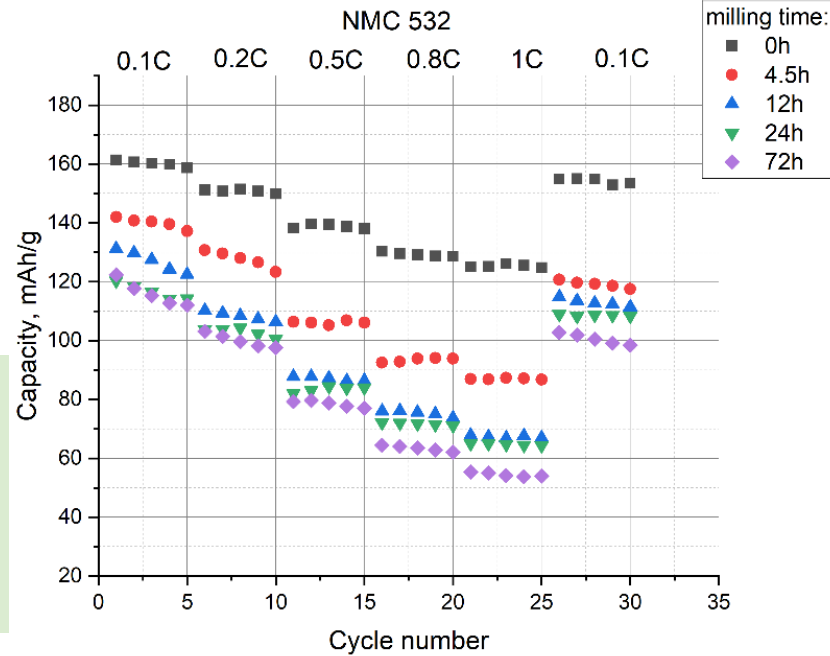
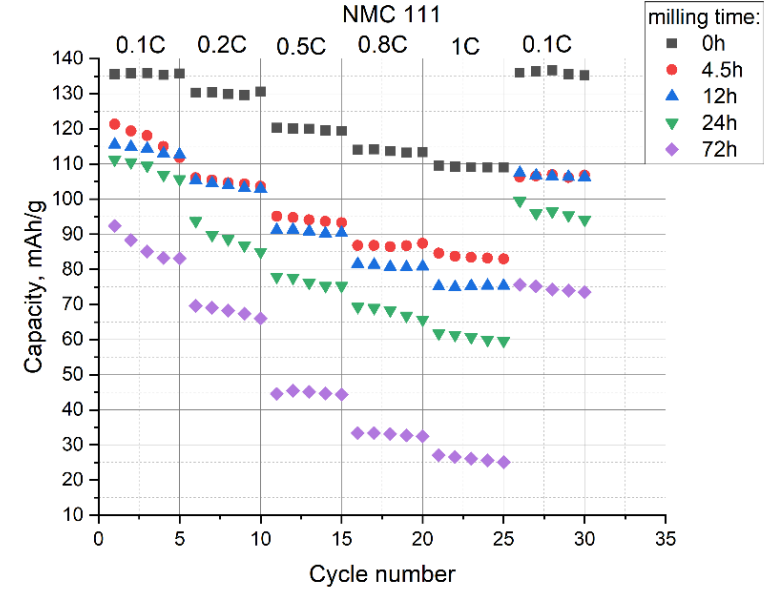
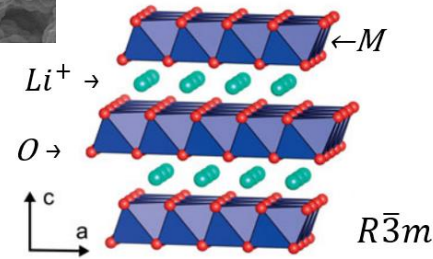
M.E. Donets, O.Yu. Ponomareva, S.V. Sumnikov, R.N. Vasin, E.A. Korneeva, N.Yu. Samoylova



Ball milling effect on NMC cathode material for Li-ion batteries



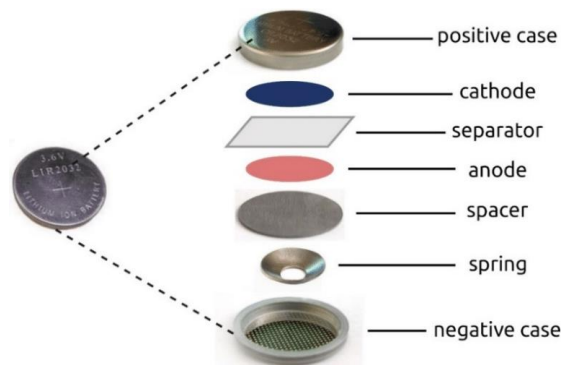
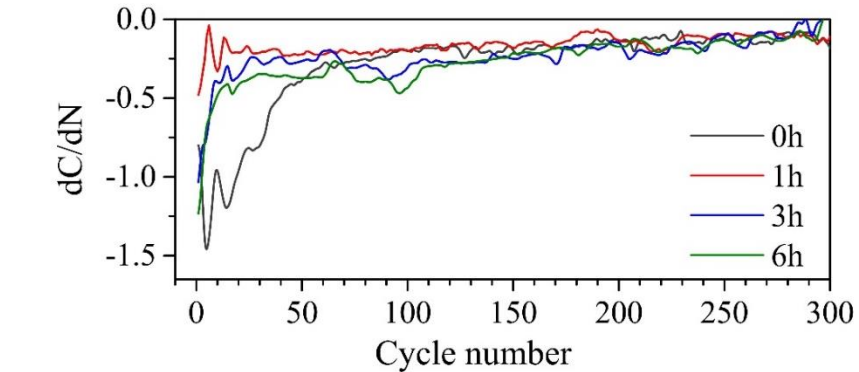
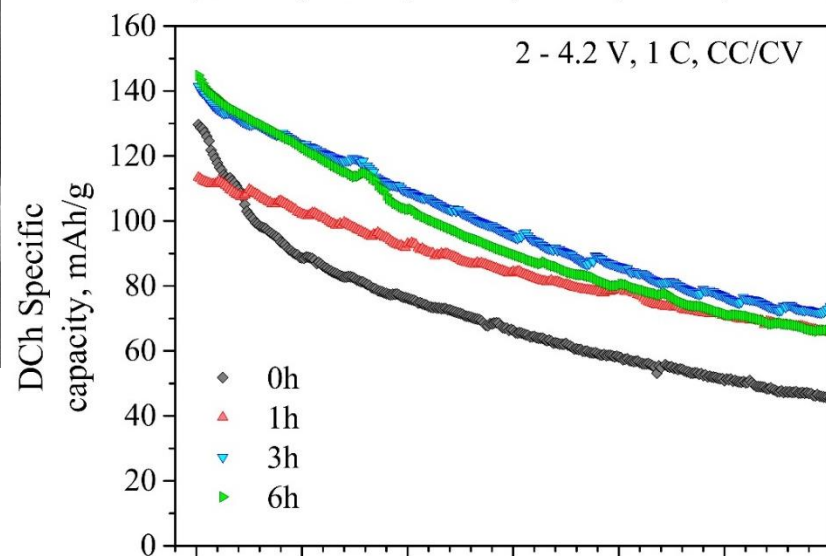
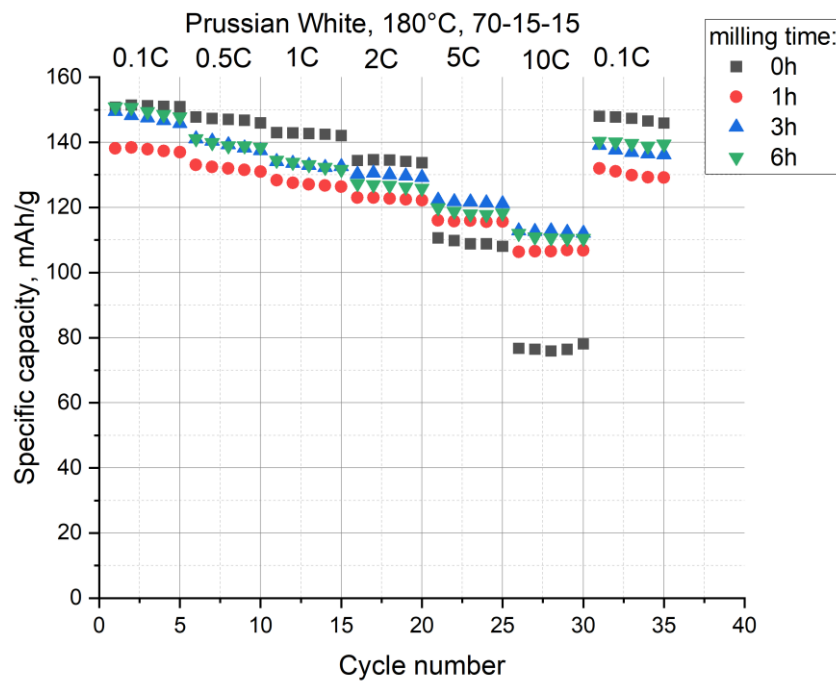
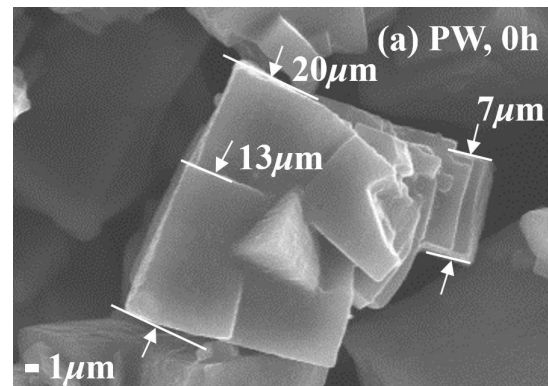
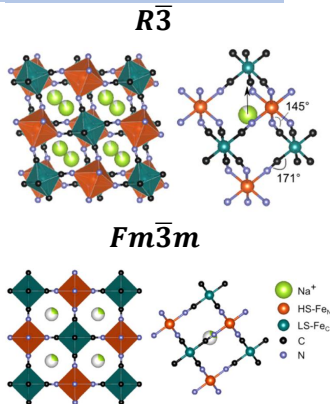
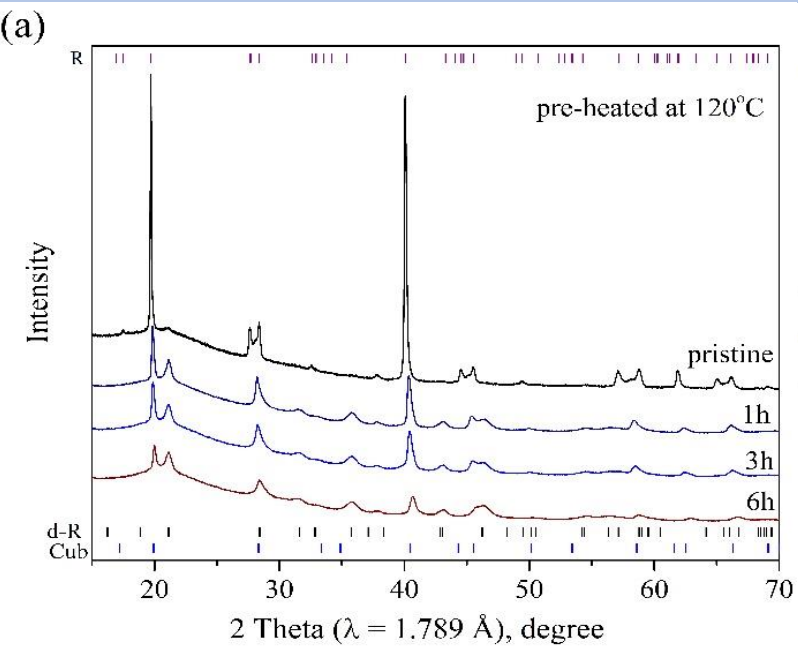
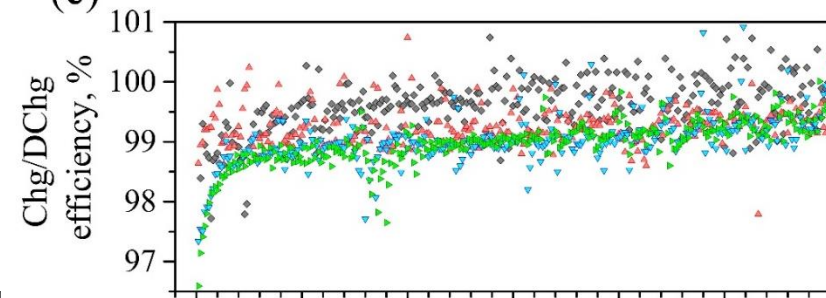
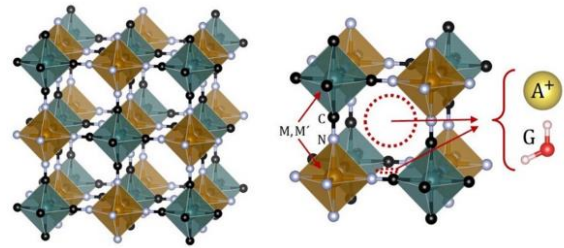
$LiMO_2$,
 $M = Ni, Mn, Co$



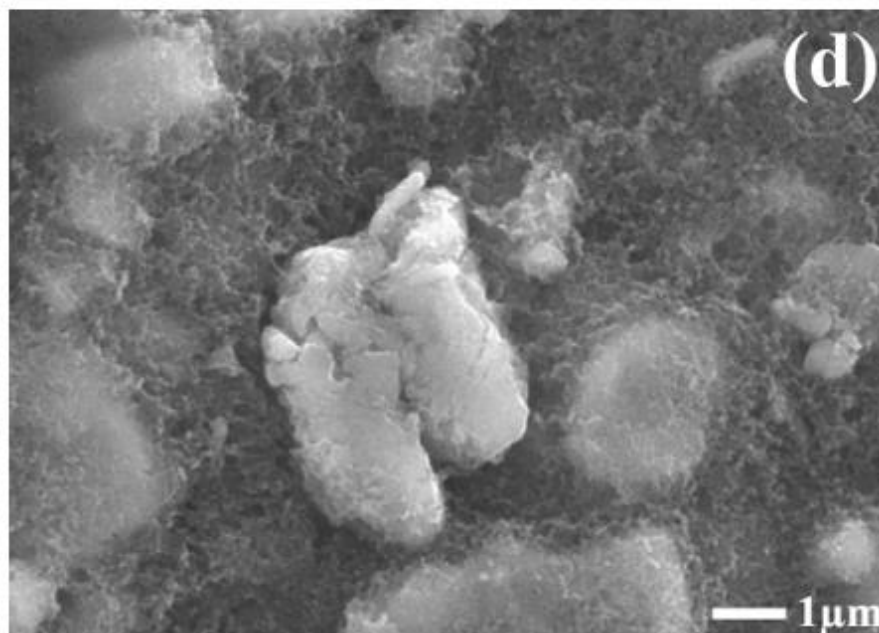
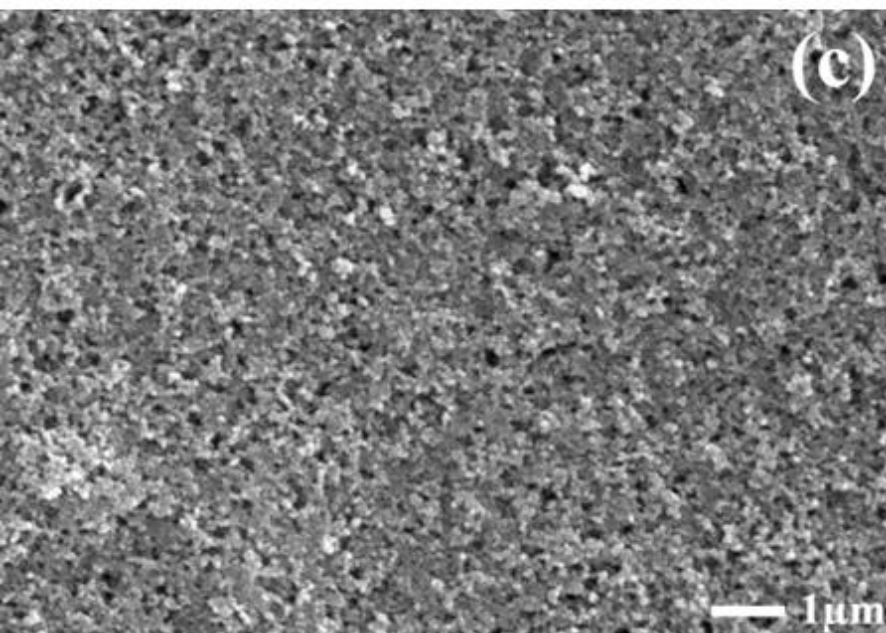
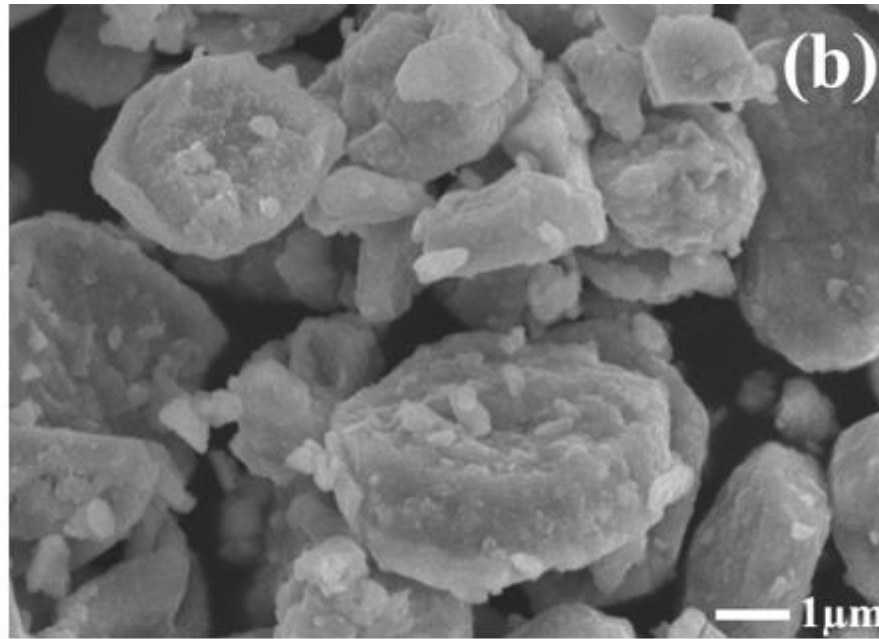
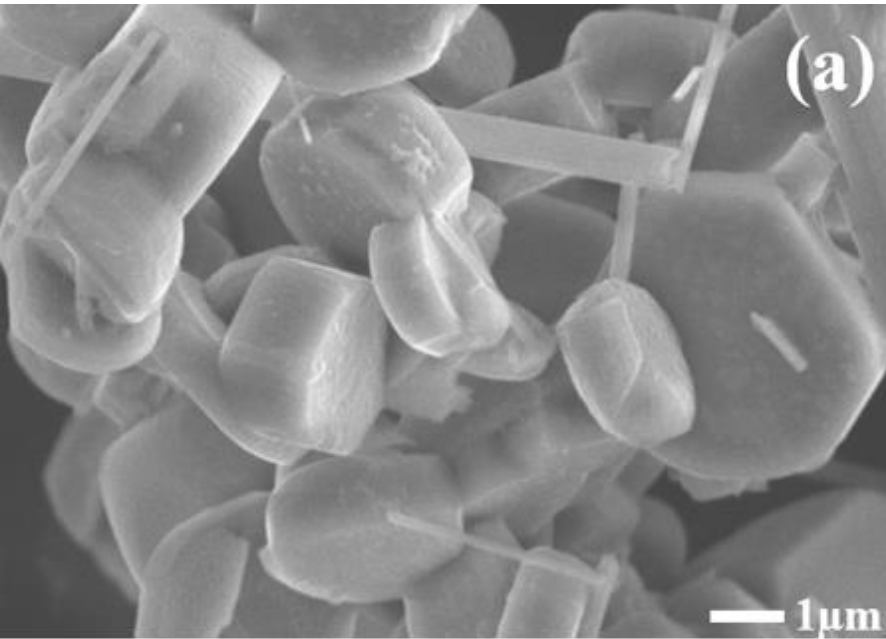
Donets M.E.,
Samoylova N.Yu,
Korneeva E.A. et al,
*Mechanical Milling
Effect on Structural*

*and Electrochemical
Properties of Cathode
Material*, PEPAN
Letters 19 (2022)
532-535

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



SEM-images of pristine and milled NMO samples



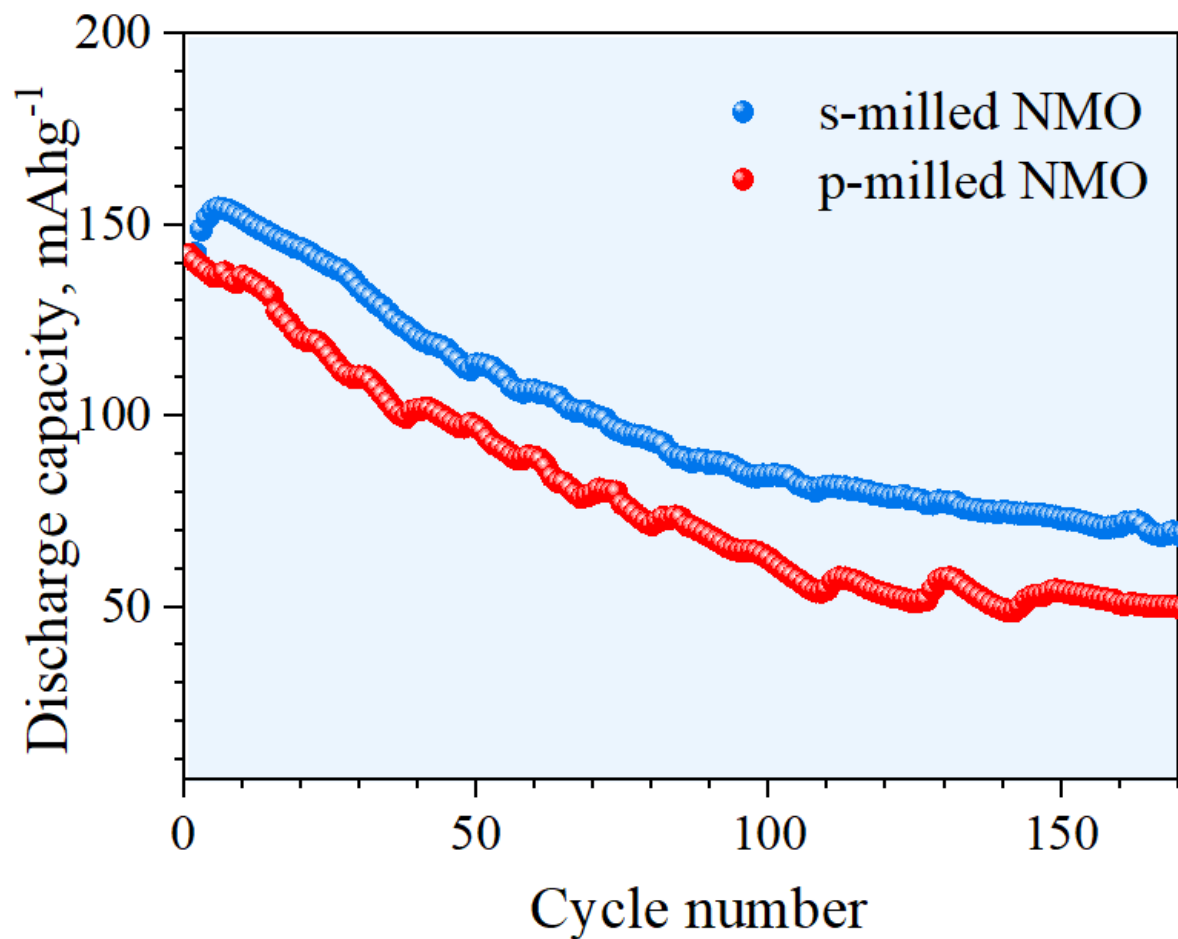
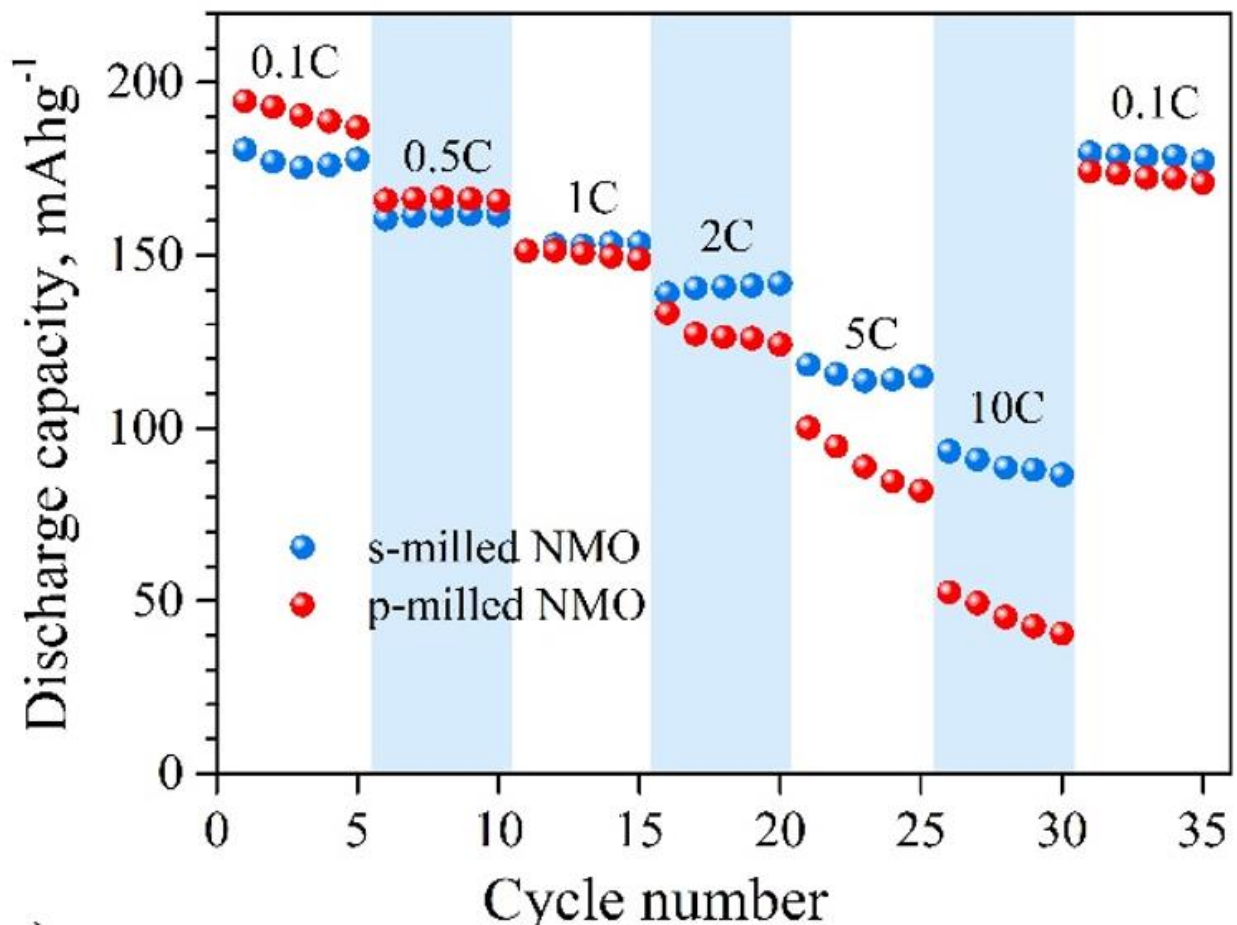
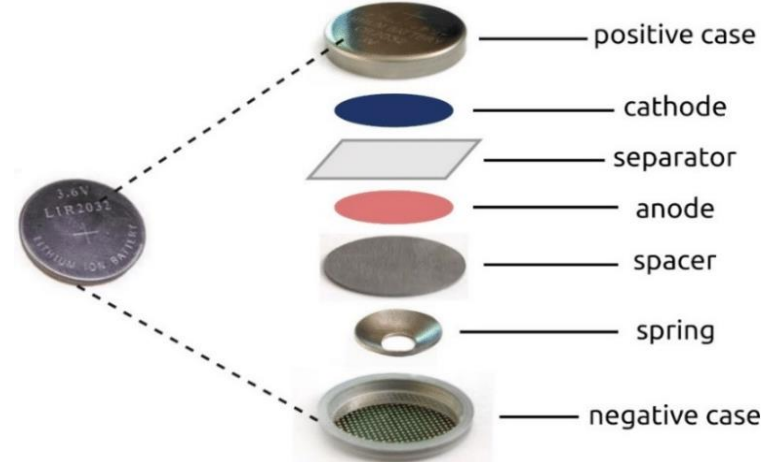
$\text{Na}_{0.7}\text{MnO}_2$, or NMO

content, at%		
Na	Mn	O
16.34 ± 0.09	36.6 ± 0.1	47.1 ± 0.2

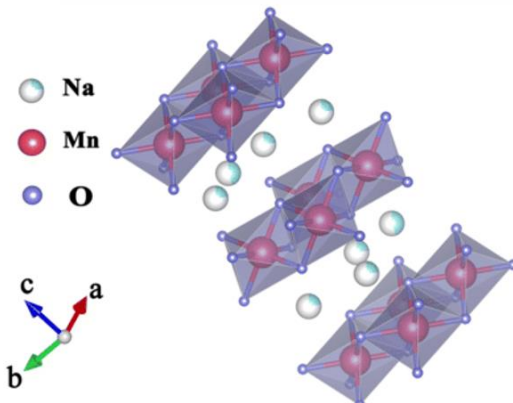
- Pristine NMO material has the morphology of a regular hexagonal prism.
- Milling program in a planetary mill: 15min at 200 rpm and 30min at 600 rpm.
- Milling was carried out both for powder and for slurry.
- The destruction of prism-shaped particles occurs as milling time increases.

Electrochemical study

Electrode composition: NMO / Ketjen Black / PVDF
Voltage window: 2 ÷ 4 V

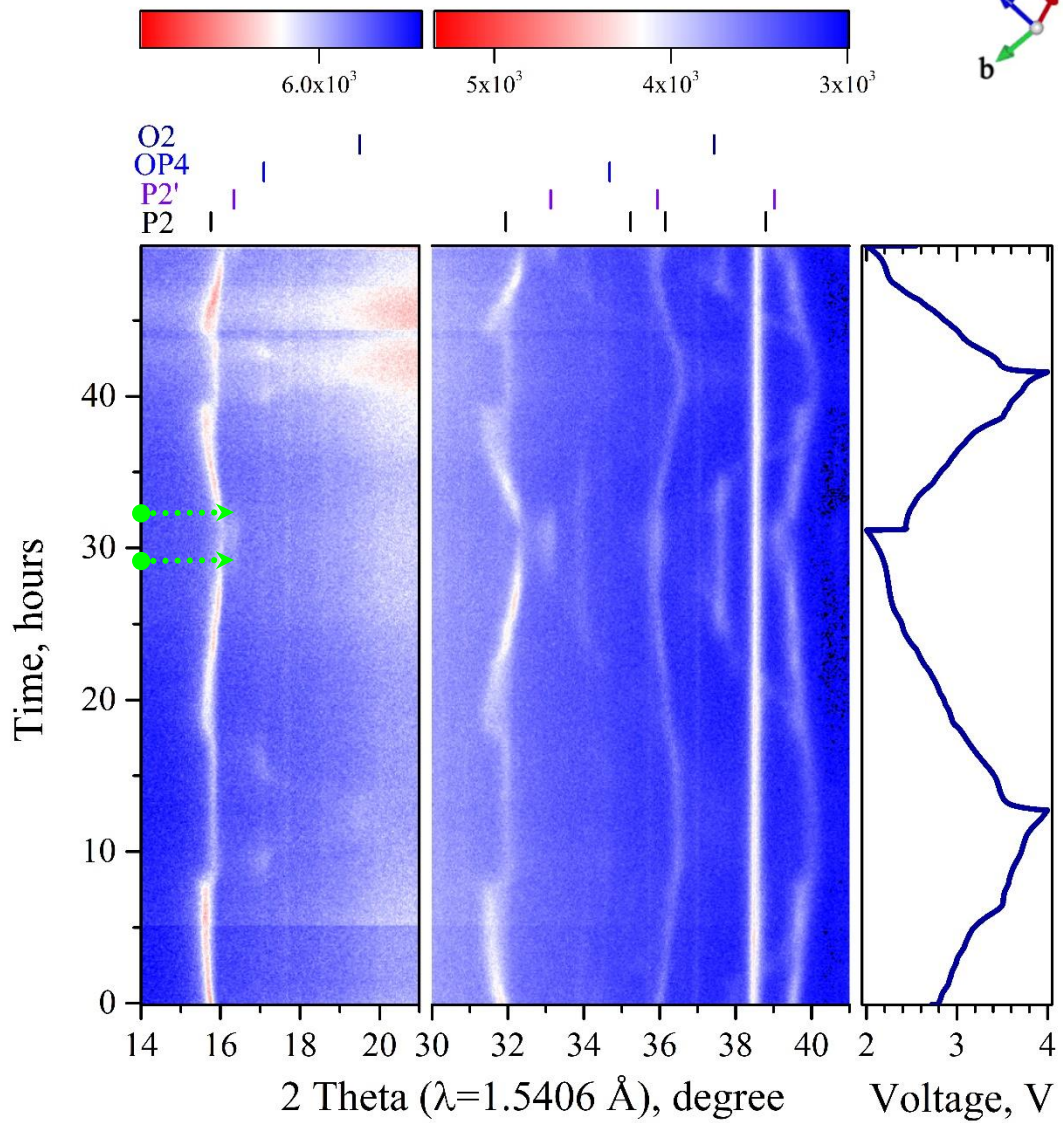
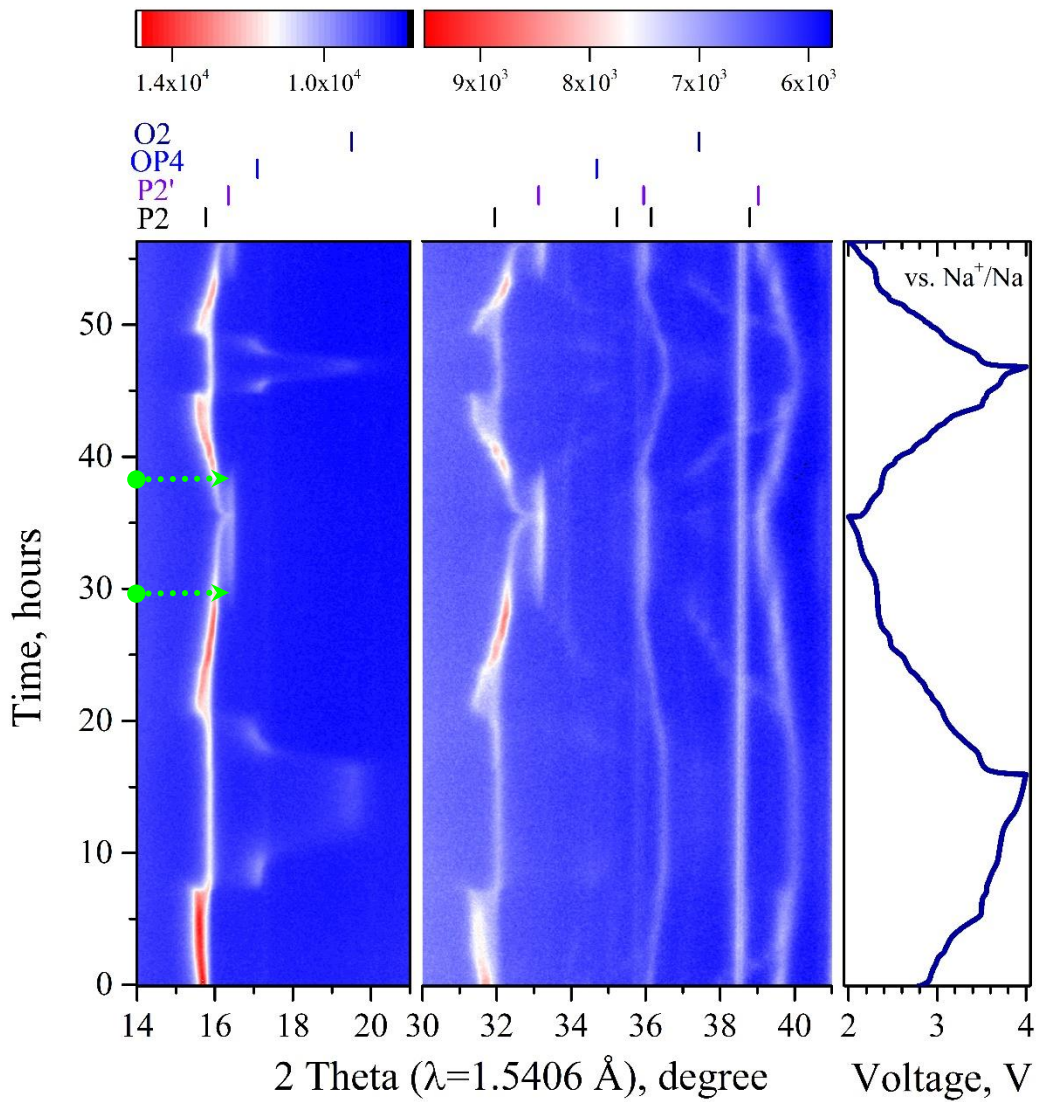


In-situ XRD patterns of the Na_{0.7}MnO₂/Na cell under a current rate of 0.1C



P-milled NMO

S-milled NMO



- DCH state: orthorhombic phase P'2.
- CH: redox reaction Mn³⁺/Mn⁴⁺ and P'2 → P2.
- S-milled: prolongation of P2 phase existing.

Results and conclusions

- Compared to p-milled, s-milled sample shows:
 1. prolongation of P2 phase existing.
 2. shortening of OP4 and O2 regions. P2→OP4→O2 appear at higher voltages.
- Both p- and s-milled NMO samples revealed higher electrochemical capacity than it is shown for pure and doped NMO in published articles.
- **0.1C - 0.5C:** The capacity of p-milled NMO is higher than that of s-milled, but this difference decreases as the current increases from 0.1C to 0.5C.
- **1C:** the capacities of both materials take approximately the same values.
- **2C-10C:** s-milled NMO shows a significantly higher capacity than p-milled and operates more stable.



S-milled NMO works better at high rates (2C, 5C, 10C) with capacities of 140mAh/g, 118 mAh/g and 90 mAh/g, respectively.

The background features abstract, wavy shapes in shades of blue and orange. A thin black line starts from the left edge, loops around, and then flows across the top of the page. Another black line starts from the bottom right, loops around, and flows across the bottom. The overall design is clean and modern.

Thank You for Your Kind Attention!