Ball Milling Treatment Effects on the Electrochemical Capacity of the P2-Na0.7MnO2 cathode material

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

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

LiMO$_2$, $M = Ni, Mn, Co$

NMC 111

NMC 32

NMC 811
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

**Na_{0.7}MnO_2**, or NMO

<table>
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<th>content, at%</th>
<th>Na</th>
<th>Mn</th>
<th>O</th>
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<td>16.34 ± 0.09</td>
<td>36.6 ± 0.1</td>
<td>47.1± 0.2</td>
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- 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 Na0.7MnO2/Na cell under a current rate of 0.1C

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

- **S-milled NMO**
  - vs. Na+/Na
• 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.**
Thank You for Your Kind Attention!