SYNTHESIS OF SODIUM-MANGANESE OXIDE MATERIALS VIA MICROWAVE DISCHARGE: FIRST EXPERIMENTAL RESULTS

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Sodium-ion batteries are attractive for grid-scale storage because sodium is abundant and chemically similar to lithium. P2-layered sodium-manganese oxide $Na_{0.7}MnO_2$ (NMO) cathodes combine low cost, good ion diffusion, and stability. Electrochemical performance correlates with particle size and morphology. The smaller particle size leads to shorter diffusion paths and larger active surface area and as a result it boosts capacity and cycling rate [1–4].

In [5], NMO was synthesized via microwave synthesis (2.45 GHz, 500 W) yielding the material with sub-1μm particles and a capacity of 200 mAh/g at 1/12C. Non-uniform irradiation limited the process, prompting tests with more powerful, uniform radiation.

Two series of plasma-chemical synthesis experiments were performed using a gyrotron at the MIG-3experimental stand. The starting mixtures comprised the following compositions: Na_2CO_3/Mn_2O_3 and $NaOH/NaNO_3/Mn_2O_3$. In both cases graphite (TIMCAL SUPER C45) was added as a conductive additive. The mixtures were placed into the plasma-chemical reactor and treated with pulses of MW irradiation (200 kW and 300kW, 4 ms). Particles of spherical morphology with a diameter ranging from 20 to 100 μm were discovered via SEM (Fig. 1). Elemental analysis and XRD were also used to analyze the obtained materials.

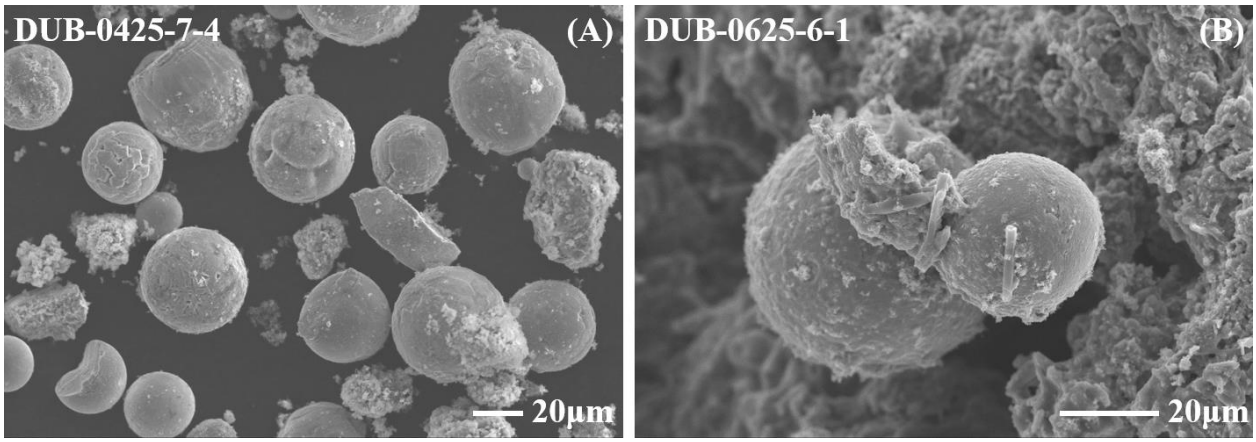

Fig. 1. SEM images of the samples prepared via plasmochemical method from (A) Na_2CO_3/Mn_2O_3 + 10% C and (B) $NaOH/NaNO_3/Mn_2O_3$ + 10% C under oxygen atmosphere.

References

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