A novel oxidation-reduction route for layer-by-layer synthesis of NaxAMnOy (A=Ni, Co, Cu) nanocrystals as cathode materials for sodium ion battery

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Statement of the Problem: Recently, large-scale energy storage technologies are in great demands for the enhanced power grid efficiency and wide renewable energy source applications. The sodium ion batteries have been proposed as the most promising solution for the large-scale energy storage systems because of the huge abundant and low cost of sodium resources. High energy-density cathode materials are now the main limits for high performance sodium ion batteries. Thus, development of high-performance electrode materials is the key for improving the energy density and increase the commercial application.

Methodology & Theoretical Orientation: In this work we suggested a novel direct and low-cost oxidation-reduction rout of layer-by-layer synthesis nanocrystals of layered transition metal oxides NaxAMnOy (A=Ni, Co, Cu) as perspective cathode materials for sodium ion batteries. The obtained nanocrystals were characterized by SEM, EDX, XRD, HRTEM, XPS, FT-IR and electrochemical techniques.

Findings: The results show the synthesized layered transition metal oxides were formed by ultrathin 2D nanocrystals (1-10 nm thick) with the so-called "nanosheets" morphology. This unique morphology provide excellent electrochemical properties characterized by the values of the specific capacity of 420-680 mAh/g, specific energy of up to 120-150 Wh/kg, the cycling stability with the drope of the initial capacity of not more than 10% after 1000 cycles of charge-discharge. Conclusion & Significance: Summery, the suggested a novel oxidation-reduction rout of layer-by-layer method will provide obtained a wide range of new inorganic nanomaterials formed by ultrathin nanocrystals of transition metal oxides, which exhibited excellent electrochemical properties as cathode materials for sodium ion batteries. From our point of view, this synthetic method also could be applicable to production of nanomaterials for energy storage, such as pseudocapacitors, zinc-ion batteries, electrocatalyst for water splitting etc.

Biography

Artem A Lobinsky is a PhD at Saint Petersburg State University. He has published 16 articles in journals, reviewed by Web of Science and Scopus. His research interests focused on the synthesis by layer-by-layer deposition method of new nanomaterials and nanocomposites for energy storage device (supercapacitor, sodium ion-battery, zinc ion-battery etc.), electrocatalysts and photocatalyst water splitting.

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