Ultrathin 2D ZnNi-LDH nanocrystals synthesis by a layer-by-layer method as a material for electrodes of high-performance alkaline battery–supercapacitor hybrid devices

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Statement of the Problem: In recent years, increasing attention directed at creating novel two-dimensional graphene-like materials, in particular materials based on oxides or hydroxides of transition metals, as they have a number of unique properties, which determine the perspective of their application in various fields of electronics and electrical engineering, as well as in energy storage devices.

Methodology & Theoretical Orientation: In this work we propose a novel promising route for the synthesis of nanolayers layered double hydroxides on the basis of zinc and nickel by a layer-by-layer deposition method. The obtained nanolayers were characterized by SEM, EDX, XRD, HRTEM, XPS, FT-IR and electrochemical techniques.

Findings: The results show the synthesized nanolayers were formed from two-dimensional nanocrystals with the thickness of about 3–6 nm and the morphology of the so-called "nanosheets" with the hydrotalcite-like crystal structure of an LDH. In addition, the obtained nanolayers were investigated as electrode materials for alkaline battery–supercapacitor hybrid devices and demonstrated a high specific capacitance (254 mA h g−1 at 1 A g−1) and excellent electrochemical stability (6% drop in capacity after 5000 charge–discharge cycles).

Conclusion & Significance: The results show that the obtained ZnNi-LDH nanolayers exhibited high specific capacity and excellent cycling stability that allows their used as an electrode material for high-performance BSH devices. We believe this novel method can be extended to prepare other ultrathin 2D materials, in particular for application in charge storage devices.

Biography

Maria V Kaneva is a PhD student at Saint Petersburg State University. She has published 3 articles in journals, reviewed by Web of Science and Scopus. Her research interests include the synthesis of new electrode materials for supercapacitors, sodium-ion batteries and electrocatalysts for hydrogen energy by layer-by-layer deposition method.

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