Title : Synthesis of Conductive MOFs for Enhanced Electrochemical Performance as Anodes in Lithium-Ion Batteries.

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Major : Industrail Chemistry

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ABSTRACT

Currently, Lithium-ion batteries (LIBs) have gained significant attention due to their high energy density, long cycle life, and excellent charge-discharge efficiency. However, commercial anode materials for LIBs still face limitations such as low electrical conductivity and restricted rate capability. This research focuses on the development of a novel anode material with enhanced structural and conductive properties by utilizing Conductive Metal–Organic Frameworks (C-MOFs). These materials possess a three-dimensional structure, high surface area, and the ability to conduct electricity through their metal-ligand frameworks. In this study, two transition metals, Cobalt (Co) and Nickel (Ni), were selected, along with the [2,2′-bipyridine]-5,5′-dicarboxylic acid (bpydc) ligand, to synthesize Co-bpydc and Ni-bpydc MOFs. Both metals are known for their electron transfer capabilities, which facilitate internal conductivity and are expected to enhance the potential of these materials as anodes for LIBs.

The research began with the synthesis of the organic ligand, which serves as the structural linker for the MOFs, via the reflux method at 106°C for 3 hours. The reaction progress was monitored using Thin-layer

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Chromatography (TLC) to ensure the complete consumption of precursors. The atomic structure of the synthesized ligand was verified using Nuclear Magnetic Resonance (NMR) spectroscopy, which showed peak positions consistent with reference data, confirming successful synthesis. Subsequently, the MOFs were synthesized using transition metals (Co, Ni, and Zn) through the hydrothermal method at 150°C for 48 hours to obtain the anode materials. Morphological characterization via light microscopy and Scanning Electron Microscopy (SEM) revealed that the synthesized Co-bpydc and Ni-bpydc exhibited micrometer-scale polygonal structures. Energy-Dispersive X-ray Spectroscopy (EDS) confirmed the elemental composition of the MOFs and the formation of coordination bonds between the metal ions and the ligands. Furthermore, crystal structure analysis was performed using Single Crystal X-ray Diffraction (SCXRD). Comparison with crystallographic databases indicated that both Co-bpydc and Ni-bpydc structures matched previously reported phases, confirming that the synthesized materials are known phases rather than novel structures.These synthesized materials will be utilized as anode materials in lithium-ion battery cells to evaluate their electrochemical properties and assess their potential for further practical applications.

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Industrial Chemistry	เคมีอุตสาหกรรม
Materials Science	วัสดุศาสตร์
Physics	ฟิสิกส์
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