Lithium and Sodium Salts of 2,5 - Pyridine Dicarboxylic Acid as Anode Materials for Secondary Batteries

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In view of the huge demand for the high energy density of battery systems for stationary applications, it is imperative for the research community to explore new directions. Organic materials for batteries have taken a leap in the recent times. Owing to their structural diversity, molecular level controllability, eco-efficient processability and resource renewability, organic electrode materials have gained much interest for next generation battery devices. [1] Most critical issues related to the wide use of organic electrodes are their low electron conductivity and poor cycling performance due to high solubility in organic electrolyte. Polymerization, salt formation, electrolyte's super concentration are some methods for decreasing solubility of active material in the electrolyte. Electronic conductivity can be tackled with proper choice of current collector and conductive polymeric backbone. [2]

Focusing on one of the organic materials, namely 2,5-pyridine-di-carboxylic acid, we tackle the solubility problem via modifying its molecular structure by forming its lithium/sodium salt. These lithium/sodium salts of 2,5-pyridine carboxylic acid were investigated as anode materials for Li- and Na-ion batteries, respectively. These compounds were characterized by various spectroscopic methods, showing excellent thermal stability up to 500°C. A combination of electrochemical, spectroscopic and computational studies revealed insertion of two Li^+/Na^+ ions per formula unit (i.e. equal to the theoretical capacity). A reversible capacity of 300 mAh/g and 270 mAh/g was achieved during Na- and Li- storage, respectively, at 0.05C rate with excellent cyclability. Good rate performance was also achieved with significant capacity retention up to 5C. The material shows a better reversible capacity, cyclability and rate performance with respect to terephthalates. [3-4] Computational studies identified a different mechanism than in terephthalates, resulting in a voltage curve with two plateaus [5].

References:

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