Electrochemical performance of organic conjugated carboxylates as anodes in sodium ion batteries

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Sodium batteries are one of the most attractive rechargeable battery systems which utilizes cheaper and more abundant sodium material but affords nearly the same power as lithium battery. A number of promising cathode materials has already been invented for sodium batteries, while the anode material investigation is lagged behind. Therefore we put our effort on new, environmental friendly anode material development for sodium batteries. Organic materials that do not include any heavy metals have recently attracted much more attention as active materials for rechargeable batteries. This contribution reports the sodium insertion in a series of carboxylate materials: ($C_8H_4Na_2O_4$), ($C_8H_6O_4$), ($C_8H_5NaO_4$), ($C_8Na_2F_4O_4$), ($C_{10}H_2Na_4O_8$), ($C_{14}H_4O_6$) and ($C_{14}H_4Na_4O_8$) which can undergo an insertion reaction with sodium at low voltage (below 0.6 V vs. Na/Na^+). These organic anode materials can insert reversibly up to 2 Na per molecule with good cycleability. 3.6 V full sodium cells using these organic anodes were successfully made and tested at both room temperature and at 55 °C. To the best of our knowledge, this represents the first example of sodium ion full cell incorporating an organic based anode material. Detailed mechanistic studies have been conducted on Na_2BDC ($C_8H_4Na_2O_4$) and NaHBDC ($C_8H_5NaO_4$) using X-ray, FTIR and EPR techniques.

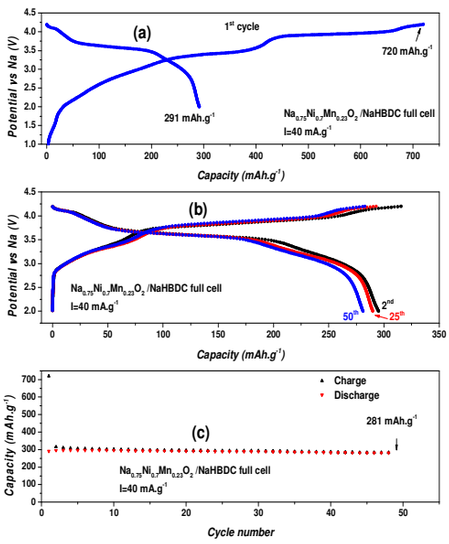

Figure. Voltage profile and cycleability of $Na_{0.75}Mn_{0.7}Ni_{0.23}O_2$ / NaHBDC full cell.

Reference

A. Abouimrane, W. Weng, H. Eltayeb, Y. Cui, J. Niklas, O. Poluektov and K. Amine Energy Environ. Sci., 2012, 5, 9632-9638.