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Partially Fluorinated Electrolyte for High-Voltage Cathode for Lithium-Ion Battery

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Abstract : A new lithium-ion battery is configured by coupling sulfurized carbon anode and high voltage $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) cathode. The anode is derived from sulfurized polyacrylonitrile (S-C(PAN)). Severe capacity fading usually becomes unavoidable due to the oxidative decomposition of solvents, primarily when a conventional carbonate electrolyte with 1 M lithium hexafluorophosphate (LiPF6) is employed. Fluoroethylene carbonate (FEC), ethyl methyl carbonate (EMC), and 1, 1, 2, 2-Tetrafluoroethyl-2, 2, 3, 3-tetrafluoropropyl ether (TTE) are formulated as the best electrolyte (3:2:5 in vol. ratio) for this new high-voltage lithium-ion battery to mitigate this capacity fading and improve the adaptability of the S-C(PAN) and LNMO. The discharge capacity of a full cell made with 1 M lithium hexafluorophosphate (LiPF6) in FEC/EMC/TTE (3:2:5) electrolyte reaches 688 mAh g^{-1} at a rate of 2 C, while 19 mAh g^{-1} for the control electrolyte. X-ray photoelectron spectroscopy (XPS) results confirm that the fluorinated electrolyte effectively stabilizes both surfaces of S-C(PAN) and LNMO in the full cell. Compared to the control electrolyte, the developed electrolyte enhances the cyclic stability and rate capability of both half cells (Li//S-C(PAN and Li//$LiNi_{0.5}Mn_{1.5}O_4$) and S-C(PAN)//$LiNi_{0.5}Mn_{1.5}O_4$ full cells.

Keywords : fluorinated electrolyte, high voltage, lithium-ion battery, polyacrylonitrile
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