Enhance electrochemical performance of sodium/carbon fluorides batteries by flexible, binder-free film electrodes

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Carbon fluorides (CF_x) are certain productions due to the impossible use directly of fluorine as cathode, despite of its superb theoretically specific capacity in lithium and sodium battery with LiF and NaF as discharge products, respectively.[1] Quite intriguingly, CF_x cathodes show rechargeable capability in sodium ion batteries until 2014,[1] which has stimulated much more and intensive research on sodium/CF_x system. In sodium secondary batteries, CF_x material exhibits impressive rechargeability but poor cycle stability (less than 10 cycles) and large voltage gap (~2000 mV).[1-2] Many different innovative approaches have thus far been in diverse cathode materials,[3-4] micro- and nanostructure designs,[4-5] and catalyst.[3] Considering the effectiveness of the 3D sandwich-like structure in Na/CF_x cells,[5] we explored to fabricate a flexible, binder-free film electrode to enhance the energy density and the longevity of life.

Home-made carbon fluorides ($CF_{1.0}$) was synthesized by fluorination of mesocarbon microbeads in NF_3 gas atmosphere. Binder-free, self-standing $CF_{1.0}$ film electrodes were prepared by vacuum filtration method using chemically obtained graphene oxide sheets (GO), electric conductor (super P) and $CF_{1.0}$ powder. In sodium batteries, $CF_{1.0}$ film electrode delivers an initial discharge capacity of 647.8 mAh g^{-1} and obtains a superb lifespan of over 100 cycles at the rate of 0.05C with a polarization of about 0.8 V. The enhanced electrochemical performance of $CF_{1.0}$ film electrode was ascribed to the 3D structure of electrode and the introduction of GO sheets.

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