MoS_2/PANI composite as suitable functional interlayer for lithium polysulfides trapping in Li-S batteries

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Lithium-sulfur (Li-S) battery technology promises much higher energy storage capacity compared to common Li-ion commercial batteries. Li-S batteries have high theoretical capacity of 1672 mAh g^{-1}, thanks to conversion reaction from solid sulfur (S_8) to lithium polysulfides (LiPS) [1]. At the same time, sulfur allows for a wide range of operation temperature, being non-toxic abundant and low-cost element.
Instead of mentioned advantages, few issues are still hindering the commercialization of Li-S battery. The main problem afflicting lithium sulfur batteries is the shuttle phenomenon, due to soluble long chain lithium polysulfides (LiPSs) generated at the cathode, which are soluble and able to migrate to the anode were they directly react with lithium, by a parasitic passivation reactions [2].
In the last years most interlayer separators are based on materials showing a great physical blocking of PS, like graphene. Unfortunately, many of these materials are still not effective enough in preserving long life performance. Recently was demonstrated that metal sulfides and conductive polymers can directly interact with lithium polysulfides through electrostatic or chemical bonds, inhibiting the dissolution of LiPSs. In particular, MoS_2 and PANI separately showed strong adsorption capability, preventing polysulfides dissolution and accelerating the redox reaction kinetics of polysulfides conversion [3][4].
In the present work we rationally designed some binary materials based on PANI and MoS_2 at different ratio, with the aim to evaluate the different role of the two components and their synergy as PS blocking agent.
By the implementation of a second layer containing the MoS_2/PANI composite directly on the top of the standard S/KjB electrode.
The systematic study confirms that double-layer containing the composite remarkably improves the performance of the sulfur cathode, showing a final specific capacity close to 600 mAh g^{-1}, 25% higher than the standard sulfur cathode, after 500 cycles [5].

References:

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