Toothpaste-like Electrode: A Novel Approach to Optimize the Interface for Solid-State Sodium-Ion Batteries with Ultralong Cycle Life

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A non-sintered method with toothpaste electrode for improving electrode ionic conductivity and reducing interface impedance is introduced in solid-state rechargeable batteries. At 70 ℃, this novel solid-state battery can deliver a capacity of 80 mAh g^{-1} in a voltage range of 2.5−3.8 V at 0.1C rate using layered oxide $Na_{0.66}Ni_{0.33}Mn_{0.67}O_2$, Na-β″-$Al_2O_3$ and sodium metal as cathode, electrolyte and anode, respectively. Moreover, the battery shows a superior stability and high reversibility, with a capacity retention of 90% after 10 000 cycles at 6C rate and a capacity of 79 mAh g^{-1} is recovered when the current rate is returned to 0.1C. Furthermore, a very thick electrode with active material mass loading of 6 mg cm^{-2} also presents a reasonable electrochemical performance. These results demonstrate that this is a promising approach to solve the interface problem and would open a new route in designing the next generation solid-state battery.

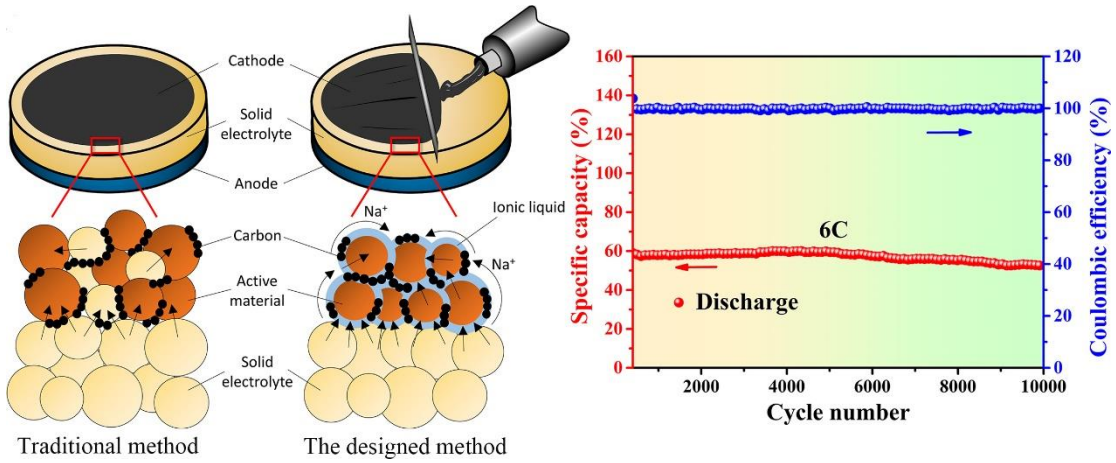

Figure 1. Schematic diagrams of (a) a conventional sintering type and (b) the designed new type solid-state battery based on an inorganic ceramic electrolyte. (c) Long-term cycling performance. Specific capacity and Coulombic efficiency versus cycle number at 6C rate.

References:

[1] Lilu Liu, Xingguo Qi and Yong-Sheng Hu et al., ACS Appl. Mater. Interfaces (2016) 8, 32631−32636.