A ceramic/PVDF composite as ion-conducting electrolyte for quasi-solid-state lithium-ion batteries

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Solid-state ion-conducting electrolytes have gained increasing attention as the safety issue of current lithium-ion batteries could be perfectly solved because they do not contain flammable liquid chemicals [1-3]. However a large interfacial resistance between cathode and electrolyte is greatly impedes the development of solid-state lithium-ion batteries. Here we report a $Li_{6.4}La_3Zr_{1.4}Ta_{0.6}O_{12}$ (LLZTO) and polyvinylidene fluoride (PVDF) composite as ion-conducting electrolyte to mediate this issue via adding a minute amount (2 μL) of liquid electrolyte (1.0 M LiPF6 in EC : DMC : EMC = 1 : 1 : 1) between the interfaces. We have found that LLZTO/PVDF membrane shows a high mechanical strength, high thermal stability and especially a high conductivity of 1.1×10^{-4} S cm^{-1}. Moreover a quasi-solid-state-lithium-ion battery of $LiFePO_4$| LLZTO/PVDF membrane|Li with the wetting surfaces delivers satisfactory rate capability and cycling stability at room temperature. For example, a battery shows an initial discharge capacity of 155 mAh g^{-1}, which slightly decreases to 145 mAh g^{-1} after 100 cycles at 1 C. Even at a high rate of 4 C, a discharge capacity of 96 mAh g^{-1} can still be achieved. Our study suggests that the liquid modifying LLZTO/PVDF membrane is a promising electrolyte for quasi-solid-state-lithium-ion batteries.

References:

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