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Poly(acrylic acid) locally enriched in slurry enhances the electrochemical performance of the SiOx lithium-ion battery anode

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Silicon oxide (SiOx) is recognized as a promising anode material for high-energy lithium-ion batteries (LIBs) due to its abundant reserves, facile synthesis, and high theoretical capacity. However, the practical use of the SiOx anode is severely hampered due to its poor cycling stability caused by a large volume change upon lithiation/delithiation. The waterborne poly(acrylic acid) (PAA) binder has been regarded as one of the most promising binders for SiOx-based anodes. In this work, a new concept is developed using locally an enriched PAA binder to enhance the structural stability of the electrode, the adhesion force between the electrode and the current collector, and the dispersion of carbon black within the electrode. By simply replacing water with an organic solvent (for example, N, N'-dimethyl formamide, DMF), the PAA binder is enriched locally in DMF because the PAA chains collapse in the DMF solution, leading to an increased functional group density. Improved electrochemical performance in terms of capacity retention and rate capacity is achieved by the locally enriched PAA binder in both half-cell and full-cell configurations. This work establishes a new concept practically feasible for applications of the alloying-based lithium-ion battery anode.

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