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**Hierarchical heterostructures of NiO nanosheet arrays
grown on pine twig-like β -NiS@Ni₃S₂ frameworks as
free-standing integrated anode for high-performance
lithium-ion batteries**

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ABSTRACT: Electroactive 3D conductive collectors of β -NiS@Ni₃S₂ are obtained from the in-situ conversion of Ni foams and exhibit unique hierarchical pine twig-like microstructure, in which the β -NiS nanorod arrays are uniformly supported on hollow Ni₃S₂ skeletons. Then the mesoporous NiO nanosheet arrays are grown successfully on the surface of β -NiS nanorods via a facile hydrothermal method and the following calcination, forming hierarchical NiO@ β -NiS@Ni₃S₂ composites. When directly used as anodes for lithium-ion batteries (LIBs), the obtained composites deliver superior lithium storage properties with a considerable reversible capacity of 498.5 mAh g⁻¹ (calculated by the mass of the whole anode including substrate) after 100 cycles and excellent rate capability, holding a great promise as free-standing integrated anodes for high-performance LIBs. The remarkable electrochemical performance could be attributed to the well-designed 3D hierarchical heterostructures and the synergy effect

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