Development of Graphene-Silicon Anode Materials and Hypotaxial Growth of Transition metal Dichalcogenides for Advanced Energy Storage and Electronic Applications

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Abstract: In the quest for enhancing the performance of lithium-ion batteries and semiconductor devices, the integration of two-dimensional (2D) materials presents a promising avenue. This study introduces the innovative development of graphene-coated silicon anodes by S-Graphene Co., alongside groundbreaking research on the hypotaxial growth of transition metal dichalcogenides (TMDs). The graphene-silicon anode material showcases significant improvements in battery capacity and cycling stability, attributed to the unique conductive and mechanical properties of graphene. This coating effectively mitigates the volumetric expansion of silicon during lithiation processes, enhancing the longevity and efficiency of lithium-ion batteries. Concurrently, our research delves into the hypotaxial growth techniques for TMD semiconductors, aiming to fabricate high-quality, large-area 2D layers. This method allows for the fabrication of 4-inch single crystal TMDs with precise controllability of the thickness, paving the way for next-generation electronic and optoelectronic devices. By combining the advantages of graphene with the versatility of TMD materials, our work sets the stage for significant advancements in energy storage solutions and semiconductor technology, offering insights into the scalable production and application of 2D materials in various industrial sectors.