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Synthesis and characterization of Si/Ni composites as negative material of Li-ion battery using PS-PVD

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Si is one of the most promising candidate materials for LiB anodes because of its high theoretical capacity of 4200mAh/g, more than 10 times higher than that of graphite [1,2]. However, presently, the practical applications of Si as an anode material have limited because of its poor cyclability and high cost. To address the above issues, substantial effort has been focused on synthesising nanostructured alloys and dispersing the active component in a matrix to form composites [2-5].

The present work describes the first use of plasma spray physical vapour deposition (PVD) to prepare nanostructured Si/Ni composites for LiB anodes. The morphology of the prepared composites was observed using X-ray diffraction (XRD), scanning electron microscope (SEM), and transmission electron microscope (TEM). Both Si and $NiSi_2$ peaks were found in the composites prepared with 5at.% Ni in XRD pattern. An average primary particle size of ~30nm was obtained; however, the secondary particles were in the range ~100μm. Moreover, anodes prepared from those composites were tested. As expected, a high rechargeable capacity of 1624mAh/g with ~97% Columbic efficiency was obtained over 30 cycles, which is more than 4 times higher than that of conventional graphite anode. The improvement in performance of the composites is attributed to its nanostructure and high electrical conductivity.

References

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