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Production of composite Si nanoparticles by plasma spraying PVD and CH_4 annealing for negative electrodes of lithium ion batteries[1]

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— Si is a promising candidate as anode of next generation high density Li ion batteries. This material, however, needs to be nanostructured, nanoparticles and C coating of active material, to cope with huge volume change and associated rapid capacity decay. Si nanoparticles with 20–40 nm have been successfully produced by plasma spraying PVD and also Si-C core-shell composite particles by adding CH_4 during processing. The battery performance has been improved with these nanopowders as anode, especially with the C coated Si particles. However, SiC that is inactive in battery reaction forms inevitably at high temperature during plasma spraying PVD and reduces the capacity density. In this work, therefore, post CH_4 annealing was attempted to form Si-C nanocomposite particles while suppressing formation of SiC. The primary Si nanoparticles were unchanged in size after annealing and were coated with the finer carbonous particles that formed after CH_4 infiltration through pores between nanoparticles. The batteries using annealed powders with C/Si molar ratio of 0.3 have shown two-fold capacity retention increase after 50 cycles with no capacity reduction associated with SiC formation as compared to the powders without C.

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