

**Evaluation of Si/C Composites as a LIB
Anode Material**

Nikolay Dimov, Masaki Yoshio
Department of applied chemistry
Saga University, 1 Honjo, Saga 840-8502, Japan.

It is well recognized that the best possibility to improve further LIB is to use second generation of amorphous anode materials with capacities much higher than the presently used carbonaceous Li^+ hosts. Among them the most attractive candidate is silicon, having theoretical capacity of ca. 4000 mAh.g^{-1} while forming alloy with the maximum possible Li uptake [1]. However, pure silicon anodes, prepared by means of conventional electrode preparation techniques have extremely bad cycling performance. To circumvent this problem, various forms of silicon containing composites have been studied so far. Elemental silicon can be used in combination with matrices like C, TiN, and various kinds of ceramics. Since the specific volume of the amorphous Li-Si alloy is 2-3 times bigger than that of the parent Si-phase, such anodes are intrinsically unstable over cycling because the large volume variations cause microstructural changes in the bulk of the anode material. Recent successful preparation of thin silicon anodes [2] has proven that the electrochemical reaction between Si and Li^+ can be enough reversible for commercialization provided these structural changes are controllable and do not cause detachment of the active material from the current collector and pulverization of the thin silicon film. However, thin silicon electrode preparation might not be an economically feasible process and therefore scaling-up of such a process could be a difficult task.

In our opinion Si/C composites are promising candidate for anode material in LIB [3,4]. Our systematic study of various Si/C composites has revealed that there is a possible trade-off between high capacity and reasonable cycling performance when silicon content lies in the range of 30-50 wt% Si. In the above case a reversible capacity in the order of 800 mAh.g^{-1} within 50 cycles could be achieved, which corresponds to approximate alloy composition of Li_2Si [5]. We believe that the life cycle of the composite can be further successfully improved by means of well-known electrode preparation techniques, widely adopted in the LIB industry. However, maximizing the life cycle of such anodes is not a trivial problem, because the complex interactions between the binder and the composite material should be understood in detail. Therefore composite electrodes, with a stable morphology, mechanically stable and having reasonable cycling performance could be prepared by means of careful optimization of the composite material and binder system. In this paper we will describe our work, which is focused on the effect of several elastomer binders and material designing on the electrodes cycling performance.

Moreover, the important parameters like the average composite particle grain size, electrode thickness, the porosity and the electrode processing conditions will be considered. All these parameters were found to be important for the further improvement in the cycling performance of this new class of anodes. Their single influence as well as their interactions with each other will be discussed.

References:

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