Thin Li_xSi Films Produced by Ion Beam Sputtering

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Pure silicon or lithium-silicon compounds, in the amorphous as well as in the crystalline state, are promising high-capacity anode materials for future applications. For an optimisation of charging/discharging times and consequently of power densities the atomic and ionic transport processes in these materials need to be investigated. Hüger et al. [1] have recently proposed a Neutron Reflectometry based method for determining diffusivities and permeabilities in thin nano-sized silicon films, which are especially interesting for battery applications. In their experiment, the silicon thin film is sandwiched between tracer reservoirs of $^6LiNbO_3$ and $^7LiNbO_3$ in form of a multilayer structure. In the present contribution, we aim to show different approaches to prepare Li_xSi thin films with Li contents $x < 0.5$ for application in the arrangement described above in order to measure diffusivities. Li_xSi layers are produced in an argon filled glove-box in order to prevent any reaction with oxygen rich atmospheres. Three different types of sputter targets for ion beam sputtering were tested: (a) melted Li_xSi alloys, (b) segmented targets from elemental Li and Si for co-sputtering and (c) electrochemically pre-lithiated silicon wafers. X-Ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and Secondary Ion Mass Spectrometry (SIMS) were used to characterise the resulting films.

References

[1] Hüger, E., *et al*., Lithium Transport Through Nanosized Amorphous Silicon Layers, *Nano Lett.* **13,** 1237–1244 (2013).