

Determination of the diffusion coefficient of lithium ions in surface coated silicon anodes of lithium ion secondary batteries

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Silicon thin film anodes for lithium ion batteries were coated by fullerene films using plasma assisted thermal evaporation technique and were studied by transmission electron microscope (TEM), FTIR and Raman spectroscopy. Li-ion diffusion coefficients (D_{Li^+}) were determined by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) methods. Using CV method, the diffusion coefficients were calculated from the linear plot between the anodic peak current and the square root of potential scan rate. The Nyquist impedance spectrum shows a single semicircle and a straight “45 degree” line in the high-mid and low frequency region, respectively. There exists a linear behavior for each curve of the real resistance as a function of the inverse square root of the frequency in a low frequency region. The determined Li-ion diffusion coefficients from CV and EIS calculations vary in the order of $10^{-9} \text{ cm}^2\text{s}^{-1}$. These values are two orders higher than those of bare silicon anodes estimated by the same procedures.