STUDY OF THE MORPHOLOGICAL EVOLUTION OF Si-BASED ELECTRODES BY MEANS OF IN-SITU X-RAY TOMOGRAPHY

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The poor cycle life of Si-based electrodes is mainly due to their large volume variation upon cycling, inducing electrical disconnections and instability of the solid electrolyte interface (SEI). The study of the morphological variation of Si-based electrodes upon cycling is thus highly relevant to evaluate their degradation and to optimize their formulation and architecture. However, this is challenging considering their complex three-dimensional structure and their major evolution with cycling. Furthermore, samples are fragile and reactive and therefore difficult to prepare for bulk observations. In this context, X-ray tomography appears as an effective non-destructive and 3D observation tool.

In this communication, in-situ synchrotron X-ray tomography analyses are performed on Si-based electrodes prepared from a pH3 buffered slurry of ball-milled Si powder + carbon black + carboxymethylcellulose (CMC) (80/12/8) loaded into a carbon paper (AvCarb EP40) by impregnation. After an appropriate image reconstruction procedure, key morphological parameters of these Si-based electrodes and their evolution with cycling are determined such as the electrode thickness and the pore size distribution and pore volume fraction as shown in Fig. 1.

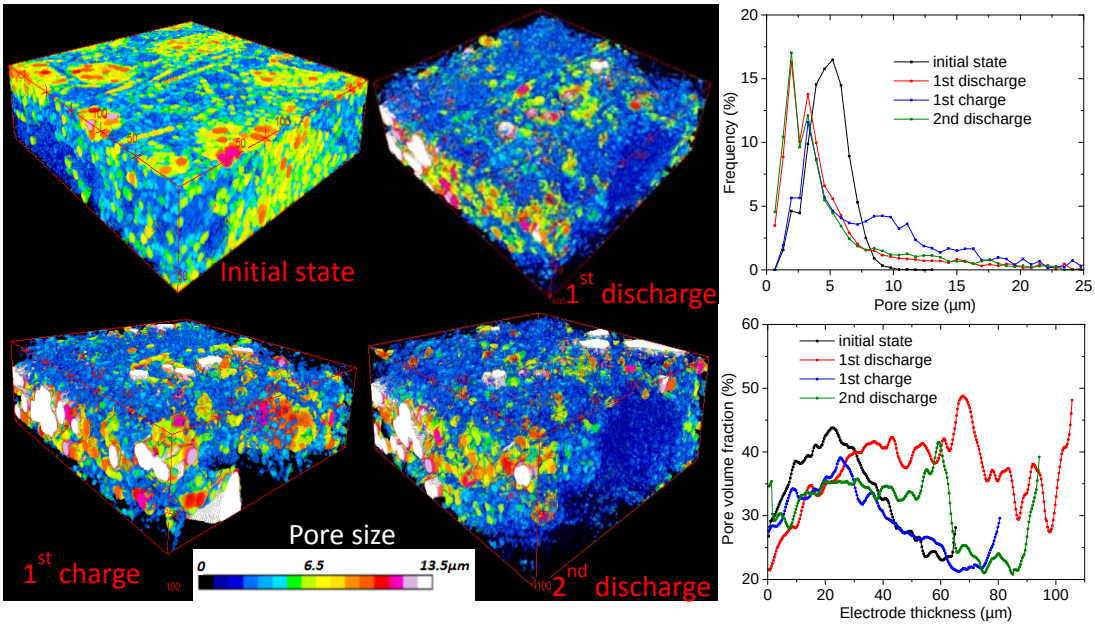

Fig. 1. Evolution with cycling of the pore size (3D view and distribution curve) and the pore volume fraction as a function of the electrode thickness for a Si-based electrode with carbon paper as 3D current collector. The initial thickness of the electrode is 85 µm and its Si loading is 1.4mg_{Si}/cm^2. Cycling was performed at a current density of 400 mA/g_{Si}, resulting in 1st discharge, 1st charge and 2nd discharge capacities of 1152, 766 and 852 mAh/g electrode, respectively.