Many in-situ methods of investigation were developed for characterizing battery materials. Electrochemical Impedance Spectroscopy (EIS) methodology offers very attractive potentialities in term of understanding what happens in many insertion films like battery materials. Advantages are related to the fact that the frequency modulation allows an easy and fast separation of the electrochemical process to be obtained. Nevertheless, in many cases, the EIS diagram interpretation is not so easy which is correlated very often to the difficulties obtaining a pertinent model. Transport and transfer characterizations of the different ionic species and the solvent can be identified. The kinetics constant rates and the relative concentration changes were estimated over the different potential values.

Different models were developed in order to describe the electrochemical behaviour of these films. A basic model can be used and was based on the ionic transfer between the film and the electrolyte. Unfortunately, good fitting are not easily reached in this case. Therefore, more sophisticated models are necessary by taking into account electronic transfer, porosity of the material and parasitic electrochemical reactions.

Figure 1 : Transfer functions obtained for PPy-pTs in NaCl 0.25 mol L\(^{-1}\) at -0.2 V vs AgAgCl: a) \(\Delta E/\Delta I\) and b) \(\Delta m/\Delta V\).

Reference:

New multi-scale approach based on ac-electrogravimetry, for characterizing insertion materials.

C. Gabrielli1,2, T.H. Ho1,2, C. Laberty-Robert3, H. Perrot1,2, O. Sel1,2 and M. Turmine1,2.
1. CNRS, UPR 15 du CNRS, LISE, 4, place Jussieu, 75225 Paris, France.
2. Université P. et M. Curie, LISE, 4, place Jussieu, 75225 Paris, France.
3. LCMCP-CNRS-UMR-7574-College de France, 11, place Marcelin Berthelot, 75231 PARIS France.

In a first step, different films were tested in order to electrogenerated. One example of ac-electrogravimetry measurement is given in figure 1 for polypyrrole made in paratoluene sulfonate (pTs). In the \(\Delta m/\Delta E(\omega)\) transfer function allows the anion and free solvent can be identified. The kinetics constant rates and the relative concentration changes were estimated over the different potential values.

Figure 1 : Transfer functions obtained for PPy-pTs in NaCl 0.25 mol L\(^{-1}\) at- 0.2 V vs AgAgCl; a) \(\Delta E/\Delta I\) and b) \(\Delta m/\Delta V\).