Dynamic multi-frequency analysis: an operando tool to probe the dynamic behaviour of electrochemical systems and reactions

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Dynamic multi-frequency analysis (DMFA) is a tool that allows acquiring dynamic impedance spectra of electrochemical systems in a large range of frequencies, from 1 MHz down to few Hz, with high time-resolved precision [1,2]. Starting from the physical definition of impedance and admittance, and using the concept of Volterra series, it has been shown how the concept of dynamic impedance is an extension of the concept of stationary impedance [3]. Here an overlook in the application of dynamic multi-frequency analysis to several electrochemical systems and reactions will be shown. In particular, several aspects of modeling and fitting the dynamic impedance spectra will be addressed, in terms of statistical analysis. It will be shown how the dynamic impedance spectra can be used to obtain precise information on the mechanism of reaction or implicit information on the electrochemical system, which can be fed to machine learning algorithms. In addition to this, a short overview on the analysis of the dynamic non-linear frequency response in electrochemical systems will be addressed, and first experimental results on electron transfer to a redox couple will be shown.

Literature:

[1] A. Battistel, G. Du and F. La Mantia, Electroanal. 2016, 28, 2346.
[2] D. Koster, G. Du, A. Battistel, and F. La Mantia, Electrochim. Acta 2017, 246, 553
[3] A. Battistel, and F. La Mantia, Electrochim. Acta 2019, 304, 513.