



3rd Global Conference on Research in Chemistry and Chemical Engineering

Prague, Czech Republic

18 – 20 September 2025

New Impedance Frequency Characteristics - Differential and Relative Impedance

Szymon Wysmulek, Kazimierz Darowicki

Gdańsk University of Technology, Department of Corrosion and Electrochemistry, Gabriela Narutowicza

11/12, 80-233 Gdańsk, Poland.

ABSTRACT

Impedance techniques are an integral part of electrochemical research. Among them, Electrochemical Impedance Spectroscopy (EIS) is one of the most widely used and well-established methods. Its modernized variant, Dynamic Electrochemical Impedance Spectroscopy (DEIS), enables quasi-stationary measurement of non-stationary processes and has become a foundation for further developments in impedance-based diagnostics. This presentation explores an alternative approach to DEIS spectrogram analysis. Traditionally, impedance is examined as a function of frequency. Here, we propose treating impedance as a function of both frequency and another independent variable, such as time, current density, or potential. This perspective allows mathematical operations to be applied to entire spectrograms, offering new opportunities for interpretation. Based on this method, we introduce two new concepts: differential impedance and relative impedance. These approaches provide enhanced sensitivity to dynamic changes in the measured system and allow for the observation of subtle variations that may not be visible through conventional analysis. The presentation will cover the theoretical background of these concepts, procedures for generating differential and relative impedance spectrograms, and challenges commonly encountered in data processing. Practical solutions to these issues will be discussed, along with the potential applications of both impedance types in the study of electrochemical systems. The benefits of incorporating these novel forms of impedance into experimental analysis will also be highlighted.

Keywords: DEIS; EIS; impedance; polynomials