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# A Rapid Method for Determining the Complete Frequency-Dependent Electrode Impedance Response (2019-021)

Utilizes heuristic knowledge of the symmetric nature across log of frequency of the impedance response of an electrode to find the full electrode response from only the high frequency portion of the impedance.

## Market Overview

Traditionally, capturing the low frequency response of electrodes involves having to capture the entire frequency range of impedance. The most critical impedance element of an electrode typically involves the low frequency response where the electrode polarization resistance is determined. Depending on the electrode and electrolyte, low frequency impedance measurements may take hours or longer to complete, which limits the utility of impedance monitoring of electrochemically active systems. In order to combat this problem, Clemson University researchers have developed a method that can significantly reduce the time of measurements from hours/days to minutes/seconds. This will make it easier to measure impedance of electrode systems in real-time, and will significantly extend the range of frequencies, over which the impedance can be determined, beyond the range measured.

## Technical Summary

This approach relies on the fact that the electrode impedance over a range of frequencies results in symmetric and anti-symmetric behavior of the phase angle and the impedance magnitude, such that once the high frequency response is known up to the mirror frequency, the low frequency response can be determined from the high frequency measurement. It provides a mathematical and graphical approach for determining the low frequency electrode response from the high frequency impedance measurements. The primary development of this technology relies on new understanding of basic electrode equivalent circuit models, and the analysis method for such models.

### Application

Medical, Scientific, Infrastructure, and Transportation

### Development Stage

Patent

### Advantages

- Opens up a range of corrosion measurement and monitoring technologies that are not currently available
- Drastically shortens time needed to capture impedance
- Extends the frequency range of analysis by exploiting the symmetry properties of general transfer functions

| App Type | Country | Serial No. | Patent No. | CURF Ref. No. | Inventors |
|---|---|---|---|---|---|
| N/A | United States | 62/821,573 | N/A | 2019-021 | Dr. Jeremy Gilbert |

## About the Inventors

### Dr. Jeremy Gilbert

Professor of Bioengineering at Clemson University

Dr. Jeremy Gilbert received his Ph.D. in Biomedical Engineering from Carnegie Mellon University in 1987. Along with being the Hansjorg Wyss Endowed Chair for Regenerative Medicine, he is also the director of the CU-MUSC Bioengineering Program and principal investigator of the Gilbert Biomaterials and Regenerative Medicine Laboratory. Dr. Gilbert's research interests include metallic biomaterials and implants, tribocorrosion, and implant retrieval analysis.

For more information on this technology contact:

A. Chris Gesswein
Director of Licensing for Technology Transfer

E: agesswe@clemson.edu
P: (864) 656-0797