ABSTRACT

Electrochemical Impedance Spectroscopy (EIS) is one of the techniques used to characterize materials by applying an AC signal with an amplitude of 10–50 mVpp to the electrodes of the test material within a frequency range of 100 mHz–100 KHz. Electrochemical Impedance Spectroscopy measurements can be disrupted by *noise* signals from both the circuitry and the external environment, which can affect the accuracy of the measurement results. The frequency of the *noise* signal falls within the measurement signal frequency range (*white noise*). Therefore, a method is needed to generate a good signal without using a filter with a wide operating frequency, as mentioned above. There are several commonly used methods for processing EIS signals, such as the Lissajous technique, Fast Fourier Transform, and Lock-in Amplifier (LIA) filter.

This capstone project is the development of an EIS measurement tool using the LIA filter solution to separate measurement signals from *noise* signals. The working principle of LIA is to multiply the main signal with the reference signal and then apply a low-pass filter to the resulting signal. The magnitude of the signal and phase difference are obtained using mathematical equations processed with the assistance of computer software. Additionally, a Graphical User Interface (GUI) has been developed using the Java programming language to facilitate users in performing automated EIS measurements. This automation system can be achieved by using a microcontroller to handle frequency changes on the function generator and sampling data using an ADC to be sent to the computer. The EIS measurement results will be displayed in Nyquist andBode plots, showing the real and imaginary impedance values and displaying the total impedance value against the AC signal frequency applied to the electrodes.

Keywords :Electrochemical Impedance Spectroscopy, Lock-in Amplifier, *Noise*,Mesarument