Software Development for Frequency Domain Spectroelectrochemical Experiments

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Spectroscopic frequency domain methods have been developed as powerful tools to study the electrochemical interfaces. In most of these methods (i.e. potential modulated electroreflectance, electrochemically modulated surface plasmon resonance and electrochemically modulated IR spectroscopy), the electrode potential is modulated and the optical signal in the reflection mode is monitored at the modulation frequency. Software commercially available from most manufacturers of electrochemical instrumentation usually allows users to perform only frequency domain electrochemical experiments, such as Electrochemical Impedance Spectroscopy. Therefore, development of automated frequency domain spectroelectrochemical experiments requires custom integration of instruments: a potentiostat and either a lock-in amplifier or a frequency response analyzer. In addition, software has to be developed for instrument control and data acquisition.

National Instruments manufactures hardware and software products (LabView, LabWindows/CVI) that form a platform for computer-based measurements and automation. An alternative approach to create the Graphical User Interface (GUI) would be to use one of the Rapid Application Development environments (Visual Basic, Delphi). By placing different components on a form and modifying their properties and events, one can quickly create GUI programs. Communication between a computer and GPIB instruments can be established by using the language interface library of GPIB functions offered by National Instruments. This library allows one to initialize, send commands to and acquire readings from the instruments via the GPIB interface. This approach for the GUI design, instrument control and data acquisition was implemented to develop software for automated potential modulated electroreflectance experiments.[1] The experimental setup included an EG&G 273 potentiostat and two lock-in amplifiers (EG&G 5210 and 7220) to simultaneously monitor both electrical and optical signals. Automation of the experimental setup greatly facilitated the data collection and interpretation.

At the present moment, the software (DABEX) is available for download to perform Mott-Schottky experiments with any of Perkin Elmer (former EG&G) potentiostats 263, 273/273A, 283 and a 5210 lock-in amplifier.[2] This software is complimentary to PowerSine, software commercialized by Perkin Elmer to perform Electrochemical Impedance Spectroscopy. DABEX can be customarily modified to perform frequency domain spectro and photo electrochemical experiments with any of EG&G potentiostats and lock-in amplifiers. Future plans include the incorporation of Stanford Research Systems lock-in amplifiers to the software.

References.

1. Dmitri A. Brevnov and Harry O. Finklea, *Journal of Electrochem. Soc.* **147(9)** 3461 (2000).

2. www.chem.wvu.edu/hfinklea/dbrevnov