

Autolab Application Note EC08

Basic overview of the working principle of a potentiostat/galvanostat (PGSTAT) – Electrochemical cell setup

Keywords

Potentiostat, galvanostat, PGSTAT, electrochemical cell, reference electrode, counter electrode, working electrode

Summary

A basic overview of the working principle of a potentiostat/galvanostat is presented. Depending on the application, the connections of the instrument to the electrochemical cell can be (or must be) set up in different ways. Below, the three commonly used electrochemical cell setups are discussed together with the role of the electrodes used in electrochemical measurements.

Basic principle of a potentiostat/galvanostat (PGSTAT)

A basic diagram of a PGSTAT is presented in Figure 1.

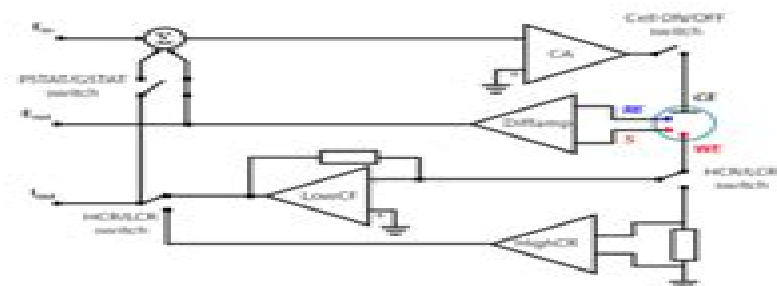


Figure 1 – Basic diagram of a potentiostat/galvanostat

In potentiostatic mode, a potentiostat/galvanostat (PGSTAT) will accurately control the potential of the Counter Electrode (CE) against the Working Electrode (WE) so that the potential difference between the working electrode (WE) and the Reference Electrode (RE) is well defined, and correspond to the value specified by the user. In galvanostatic mode, the current flow between the WE and the CE is controlled. The potential difference between the RE and WE and the current flowing between the CE and WE are continuously monitored. By using a PGSTAT, the

value specified by the user (i.e. applied potential or current) is accurately controlled, anytime during the measurement by using a negative feedback mechanism.

As can be seen from the diagram, the CE is connected to the output of an electronic block which is called Control Amplifier (CA). The control amplifier forces current to flow through the cell. The value of the current is measured using a Current Follower (LowCF) or a Shunt (HighCR), for low and high currents, respectively. The potential difference is measured always between the RE and S with a Differential Amplifier (Diffamp). Depending on the mode the instrument is used (potentiostatic or galvanostatic) the PSTAT/GSTAT switch is set accordingly.

The signal is then fed into the Summation Point (Σ) which, together with the waveform set by the digital-to-analog converter (E_u) will be used as an input for the control amplifier.

The cell cables of the Autolab PGSTAT (figure 2) have a total of five connectors: WE, CE, RE, S and ground. The potential is always measured between the RE (blue) and the S (red) and the current is always measured between the WE (red) and CE (black). The ground connector (green) can be used to connect external devices to the same ground of the PGSTAT.

Basic Overview Of The Working Principle Of A Potentiostat

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