ACM Instruments

IR Compensation

When current flows in an electrochemical cell, there is a finite solution resistance. This resistance creates a voltage drop (IR) along the current path. The potential measured between the working electrode (WE) and the reference electrode (RE) has an error of E_{iR} = IR. The magnitude of E_{iR} depends on the level of current (I), the solution resistance (R), and the distance of separation between the tip of the RE and the surface of the WE.

In systems with low current flow and high conductivity this is no problem, but low conductivity such as pure water or high currents such as sacrificial anode research can lead to errors with uncompensated systems.

The best way to compensate for IR drop is to measure the solution resistance with an AC signal and then adjust the output voltage with a PiD control algorithm. In practice it is best to initially perform a full AC scan on any new or unknown cell to determine the best single frequency to use for subsequent IR compensation. Current interrupt IR compensation looks good on paper but in practice it can be the biggest cause of unstable potentiostats there is. Having made both styles ACM know that our digital PiD method is much more stable than positive feedback current interrupt. The reason people use current interruption is one of cost, as it's much cheaper to put an interrupter in the circuit than incorporate a full blown AC analyser. Using our own on-board DSP the solution resistance can be found in 1 second then used correctly.

The solution resistance used in our algorithm may be either measured within the sequence or entered as a manual resistance. This is then used to apply a compensating potential to the potentiostat that sums with the applied cell potential to give the required potential at the electrode surface.