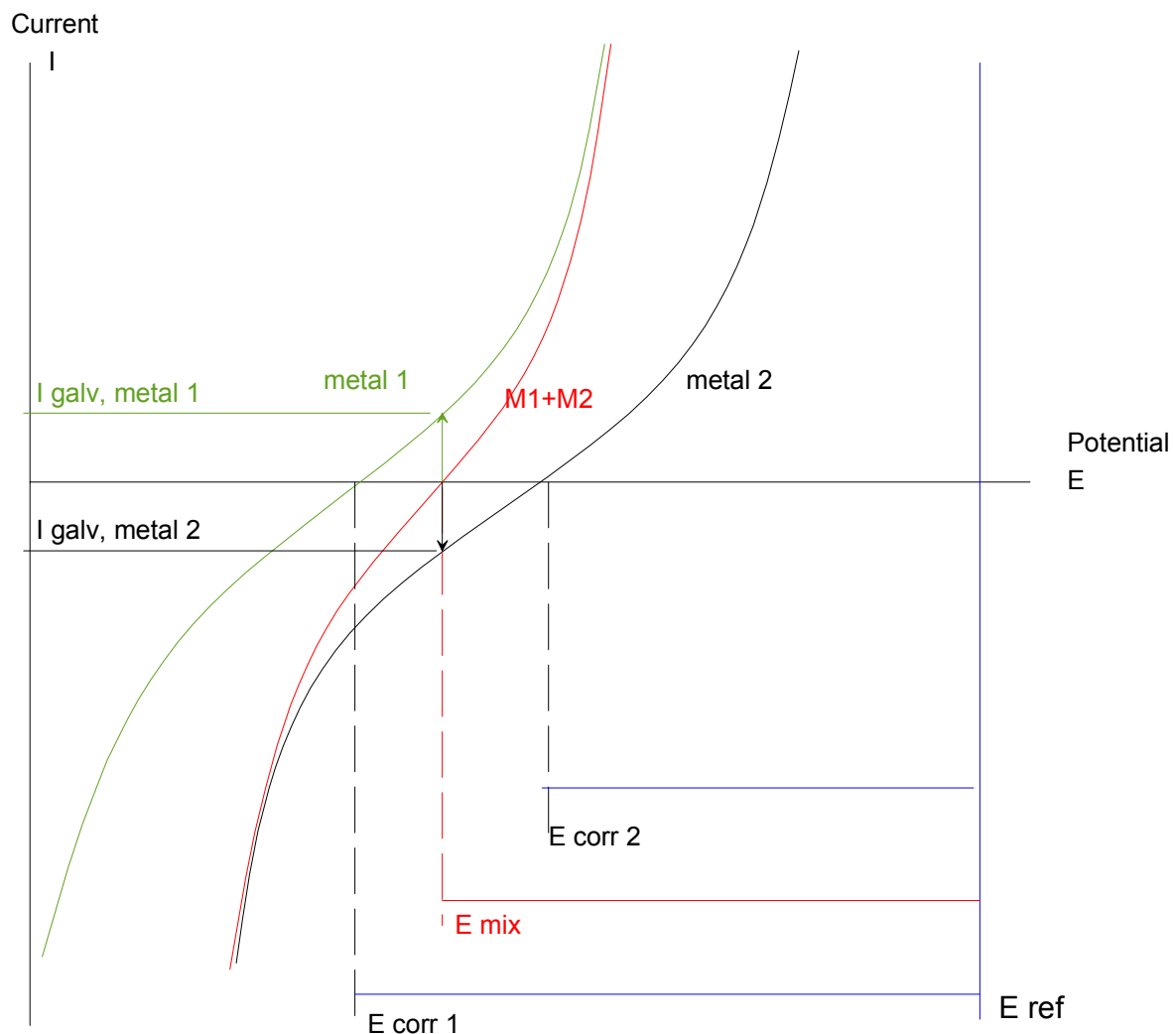


Galvanic Corrosion Research

Theoretical Aspects

Imagine you measured in one experiment the green polarisation curve below, showing active dissolution of metal 1. In another experiment using a different metal in the same environment you got the black polarisation curve.



For both metals you could calculate the corrosion current densities I_{corr1} and I_{corr2} from the semi-log Tafel plots. If you connect both metals to one another, you would get a polarisation curve like the red one plotted above. You could calculate the corrosion current density for this pair of electrodes, which is shown as " I_{galv} " here.

Besides small displacements I_{galv} will be the current which is found when you measure the polarisation curve of the coupled electrodes. However: I_{galv} is NOT the total corrosion current of metal 1, but the contribution of the galvanic coupling to the corrosion current of metal 1 as a single electrode: The corrosion current of metal 1 coupled to metal 2 is (approximately) the sum $I_{\text{corr, metal1}} + I_{\text{galv}}$.

Accordingly, the corrosion current of metal 2 decreases by:

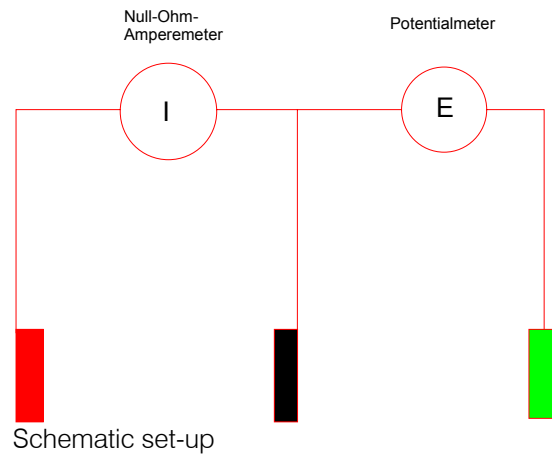
$$I = I_{\text{corr } 2} - I_{\text{galv, metal 2}}$$

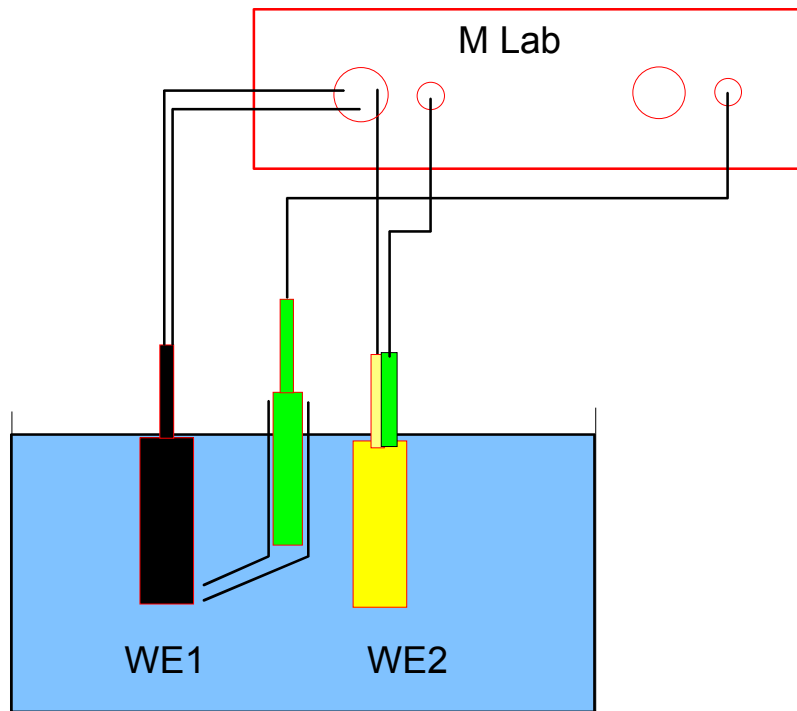
(while $I_{\text{galv, metal 2}} = -I_{\text{galv, metal 1}}$)

Since the corrosion potentials E_{corr1} and E_{corr2} are different, the corrosion potential of the galvanic coupling is a mixed potential between E_{corr1} and E_{corr2} .

Practical measurement using MLab:

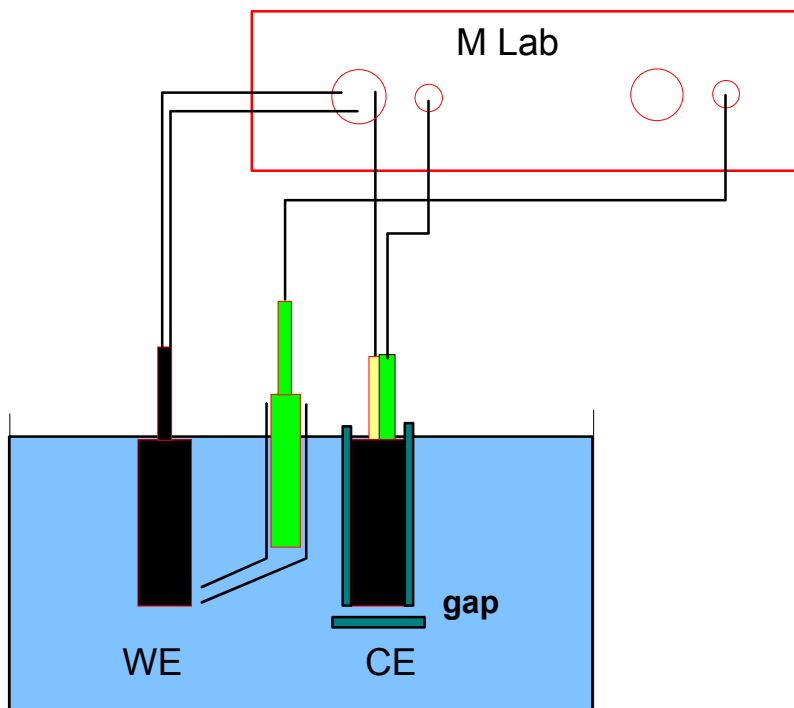
Use channel 1 of the MLab to measure the short circuit current using the ZRA- set-up given in section "Short Circuit Measurement", and use the reference electrode input of channel 2 to measure the potential of metal 1 coupled to metal 2 via the ZRA. The potentials of both metals are identical now; therefore the Haber-Luggin-capillary may be placed to either of the electrodes.





Connecting the MLab for measuring galvanic couplings: WE2 is then the second metal, connected to the counter electrode terminal. When the potential is controlled to 0, the current passing between WE and CE is the galvanic current I_{galv} .

As a special case, metals 1 and 2 may be identical, but the local environment is different. This is the case when you consider passive metals, and one of the electrodes is situated in a narrow gap. The oxygen concentration there will decrease, and it may start to corrode actively: crevice corrosion happens.



Crevice corrosion research: electrodes made of identical materials are used. One of them is open to the bulk solution; the other one is situated in a narrow gap.