Primary Method for Electrolytic Conductivity

3.202 Metrology in Electrochemistry

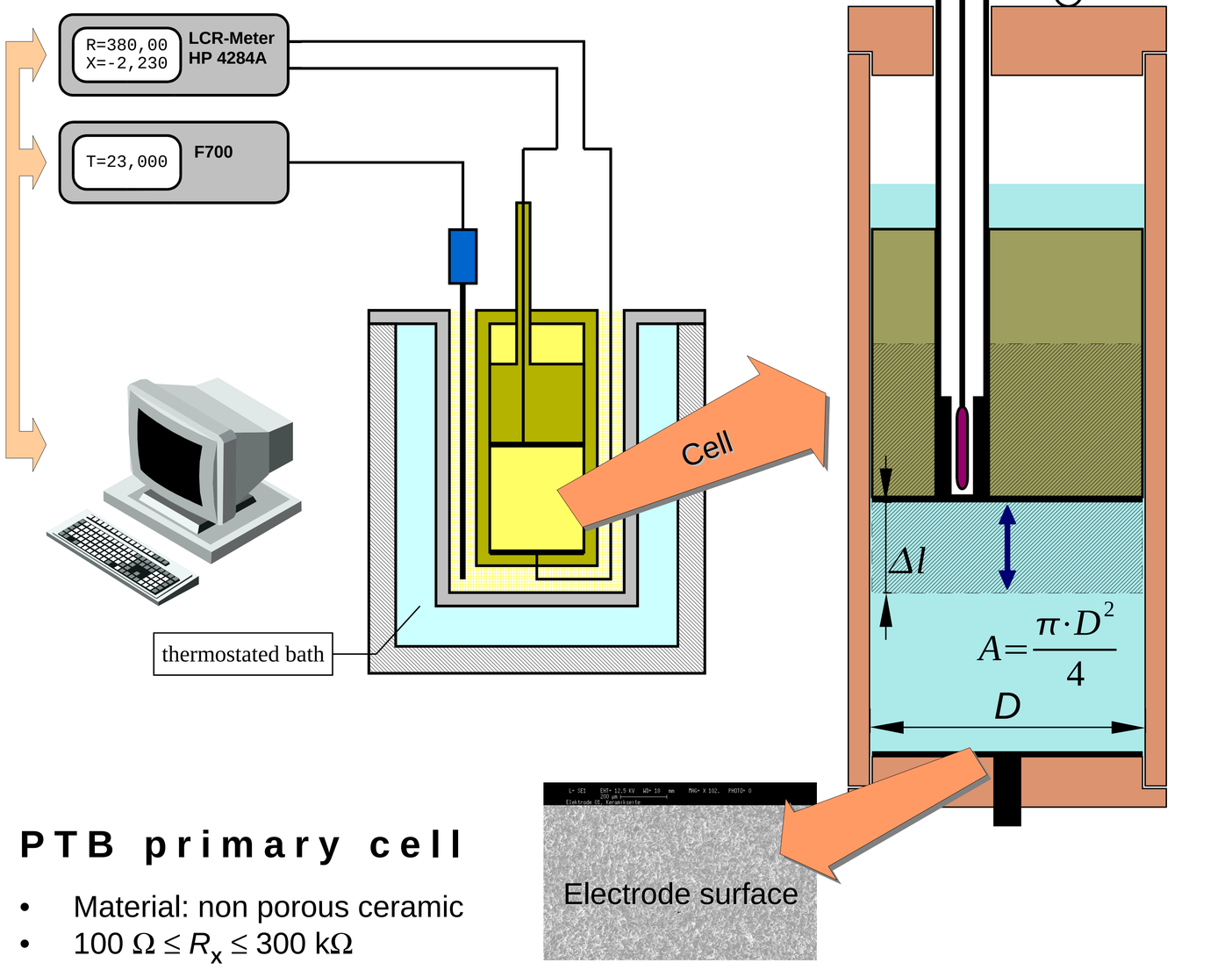
Motivation

Electrolytic conductivity (κ)

- is a measure of the concentration of ions in solution
- is an important control parameter of the purity of water
- the conductivity measurements traceable to the SI are required by regulatory bodies

Aim

To establish a traceability chain in Germany based on a primary method for conductivity



PTB primary cell

- Material: non porous ceramic
- 100 Ω ≤ R_x ≤ 300 kΩ
  400 Hz ≤ f ≤ 5 kHz

Side effects are eliminated by altering the electrode spacing
Reactance is a function of frequency only
The resistance is derived by

$$R = \lim_{\frac{1}{f} \to 0} \Delta R(f)$$

How to realize?

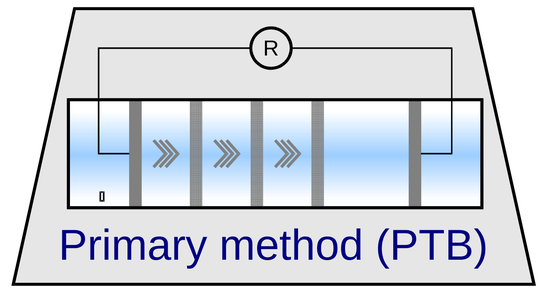
The electrolytic conductivity κ is calculated from the resistance R of the sample in the cell, in the position of the unknown impedance of an alternating current bridge.

A novel primary two-electrode cell with variable electrode spacing enables measurements over a wide range
2 µS cm^{-1} ... 10 mS cm^{-1}

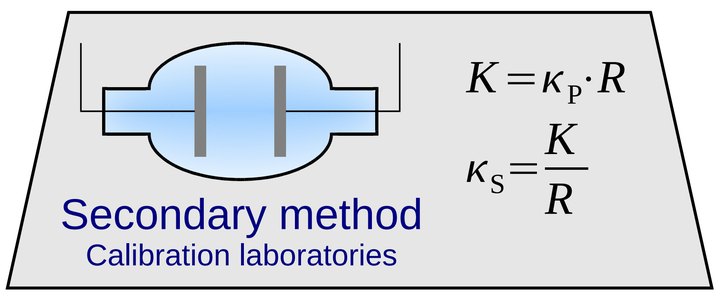
The cell constant K is calculated from dimensional measurements

$$K = \frac{\Delta l}{A}$$

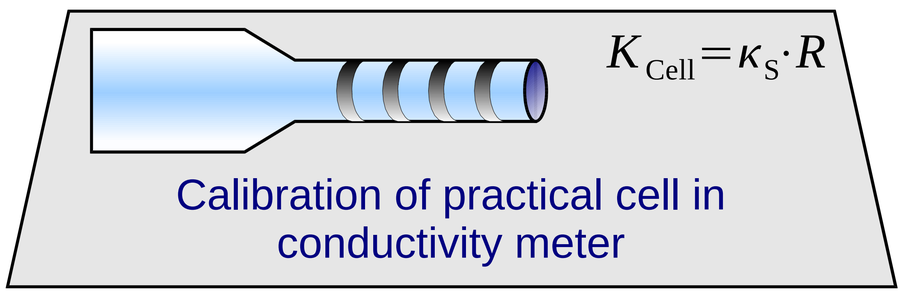
$$\kappa_P = \frac{K}{R_O - R_U}$$



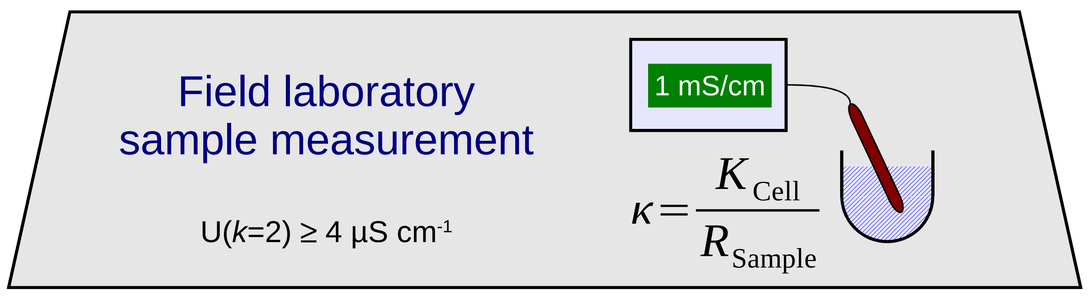
Primary reference solution
$U(k=2)$ = 0.2 µS cm^{-1}



Secondary reference solution
$U(k=2)$ = 1.4 µS cm^{-1}



Calibrated cell



Future work

- Improving temperature control
- New software for computer aided measurement evaluation
- Establishing of a calibration facility for pure and ultra-pure water

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