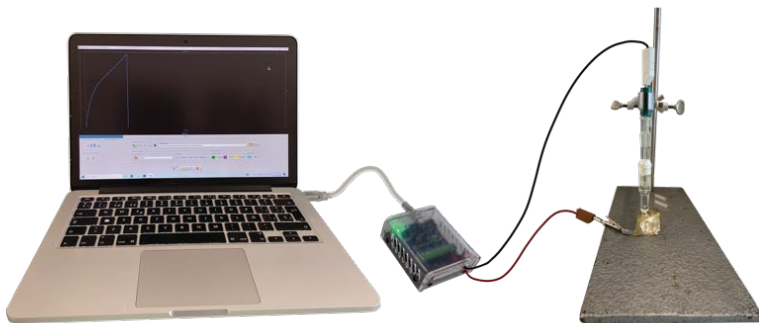Pablo General Toro's STSM

"**Combining user-friendly electrochemical hardware and a freely accessible application for the chemical analysis of modern copper-based alloys**"
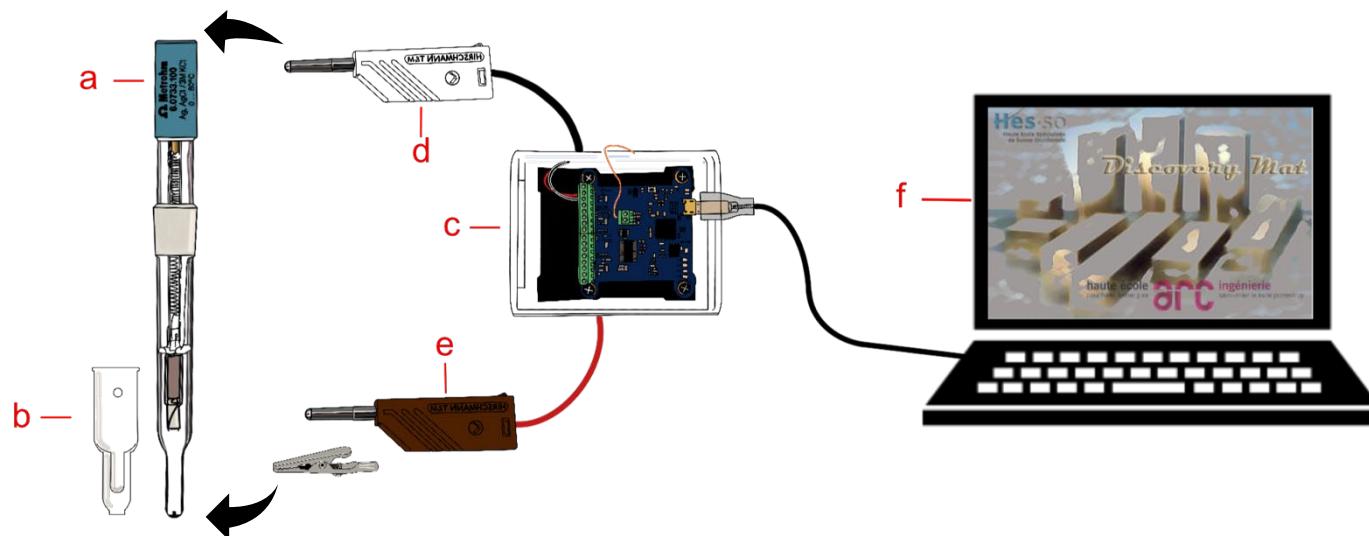
1. Setting up of DiscoveryMat device

2. Sample polishing

3. Preparation for the measurements

4. DiscoveryMat measurements

5. Comparison of Ecorr measurements with the DiscoveryMat database

6. XRF analysis of samples: validation of results and enrichment of the database

1. Setting up of DiscoveryMat device

DiscoveryMat is a low-cost analytical tool designed by HE-Arc CR in Neuchatel, Switzerland. It consists of the following elements:

a – Ag-AgCl reference electrode (RE)
b – Junction tube
c – Yoctopuce voltmeter

d – White banana plug (linking the voltmeter to ER
e – Brown banana plug – crocodile clip (linking the voltmeter to the sample using an aluminium foil)
f – Software DiscoveryMat

2. Sample polishing

The roughness of the samples made it necessary to polish them to achieve a smooth surface. Polishing was carried out under running tap water to avoid overheating and possible alteration of the metal microstructure.
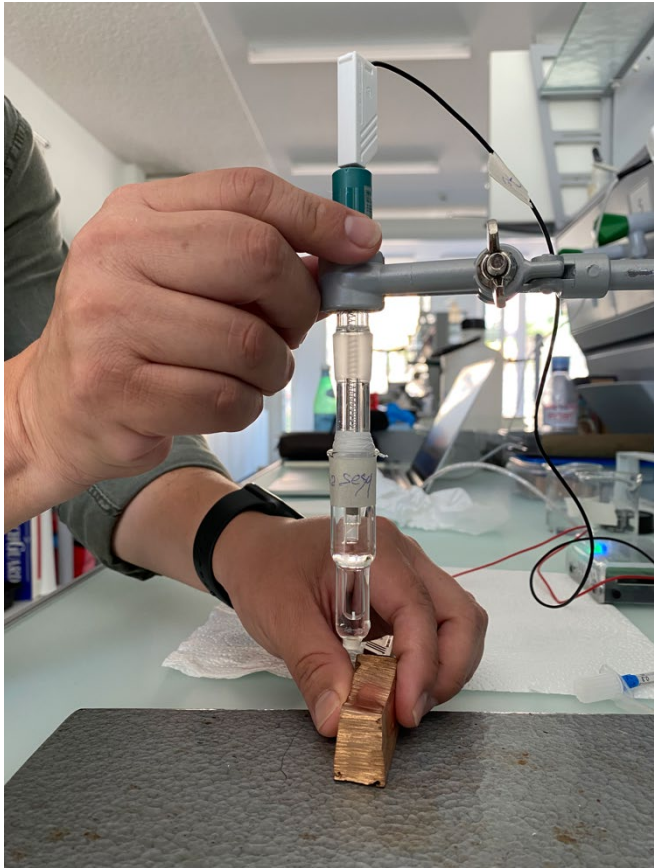
3. Preparation for the measurements

Step 1: Preparation of RE + junction tube + solution (Evian, 1%(w/v) KNO3 or 1%(w/v) NaSesq). The RE + junction tube have to rest 20 minutes in the solution before the measurements.

Step 2: Connection of Yoctopuce voltmeter to RE (white banana plug) and sample (brown banana plug + crocodile clamp + aluminium foil placed under the sample).

**Step 3:** Connection of Yoctopuce voltmeter to computer (USB port)
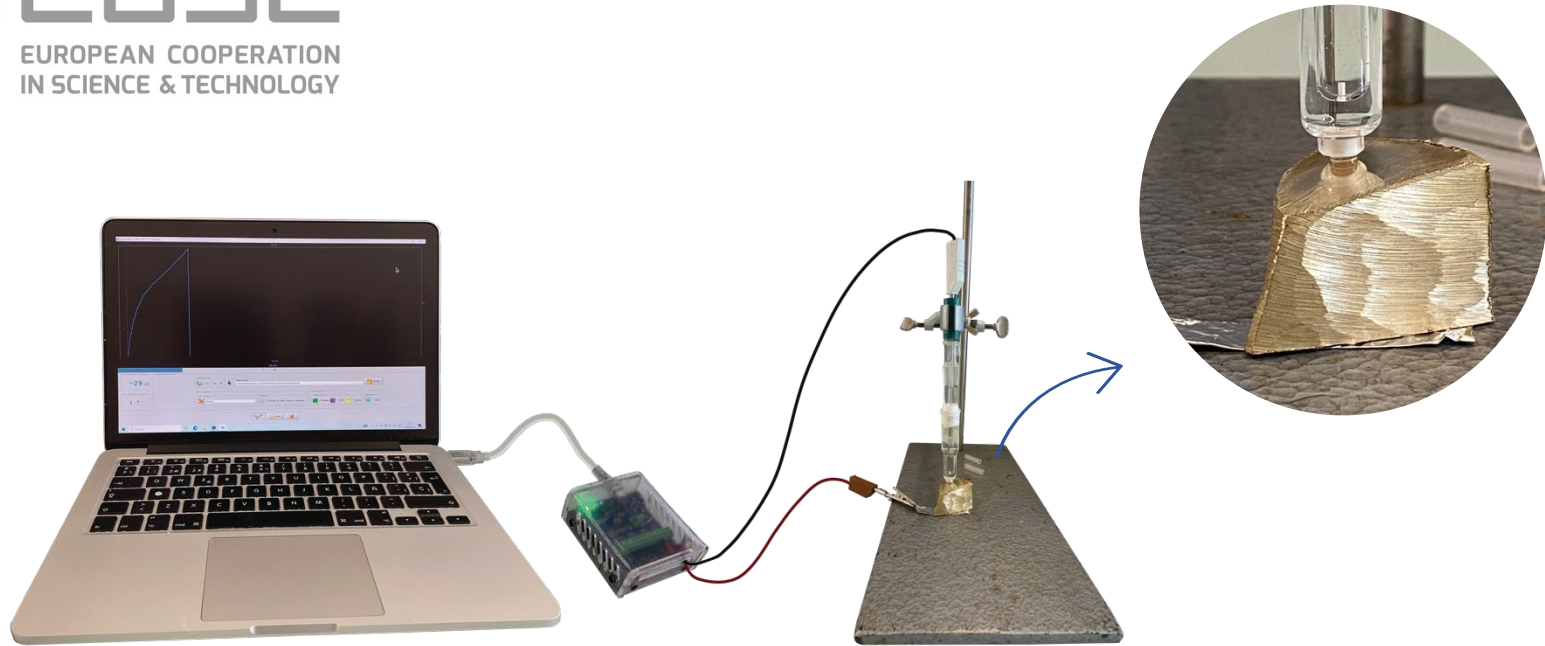
4. DiscoveryMat E_{corr} measurements

A drop of solution is inserted with a syringe between the polished surface of the sample and the tip of the junction tube. Three seconds are required before starting the measurement.

Each solution is measured three times: twice for 5 minutes and once for 15 minutes.

A 15-minute scan is deemed successful if the data for the first 5 minutes is between those of the two preliminary 5-minute scans.
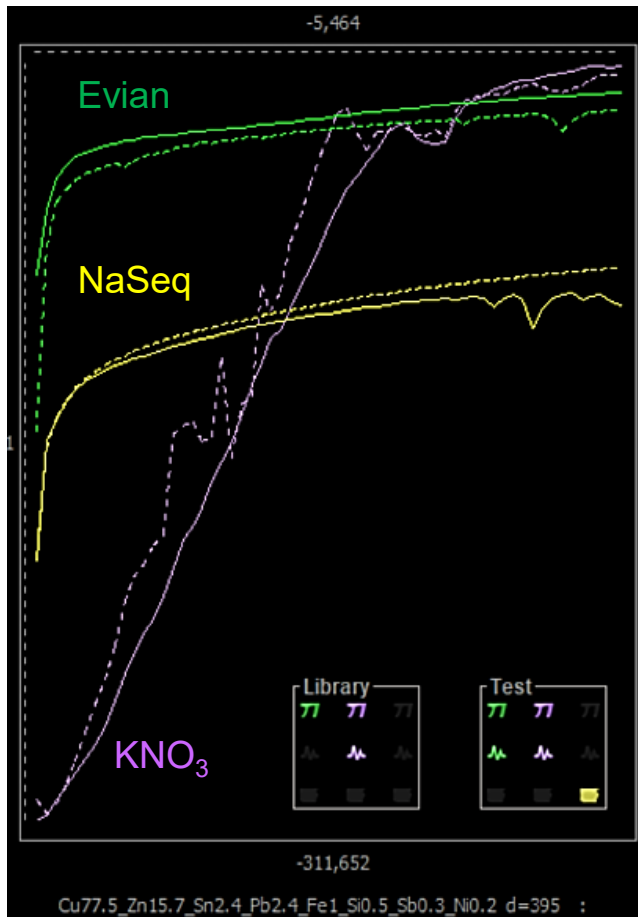
5. Comparison of E_{corr} measurements with the DiscoveryMat database

Analysis of the four samples using DiscoveryMat software provided information on the chemical composition of the alloys by comparing the E_{corr} versus time plots obtained with those in the DiscoveryMat database.

The example opposite shows that the plots for sample 1 (the solid coloured lines) show parallelism with the material considered closest in the DiscoveryMat database (the dotted lines), particularly towards the end of the measurements. Fluctuations in the KNO_3 plot (violet) suggest a Pb content greater than 1%. However, in the NaSesq plot (solid yellow), the fluctuations in the plot are not yet understood. The data characterising the reproducibility of the plots, the fluctuations in the potentials and the presence of stains (inputs) are fairly similar between the material tested and its closest alloy in the database.
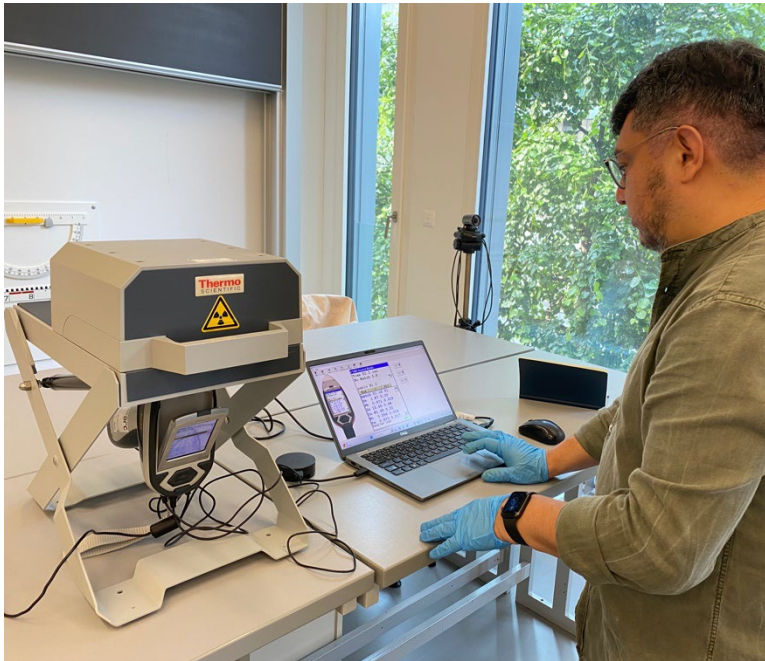
6. XRF analysis of samples: validation of results and enrichment of the database

X-ray fluorescence (XRF) analysis of the samples was used to validate the results obtained with DiscoveryMat.

This information is crucial for integrating the results obtained with DiscoveryMat into the software database, thereby enriching it.