Valentina Ljubić Tobisch‘s STSM

„Training in the analytical possibilities of the electrolytic pencil Pleco and comparison with a similar, self-made pencil”

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1. Assembling Pleco and shaping the nozzle pads
2. Setting up the Pleco and determining the working parameters
3. Characterization of artificially tarnished pure silver (Ag999) and sterling silver (Ag925) by LSV
4. Determination of the duration of tarnish degradation by chronoamperometry
5. Comparison of the two electrolytic pencils - newly built Pleco versus Vienna pencil
6. Comparison of GC electrode and two different Faber-Castell graphite leads
7. Performance of LSV on historical objects with Pleco

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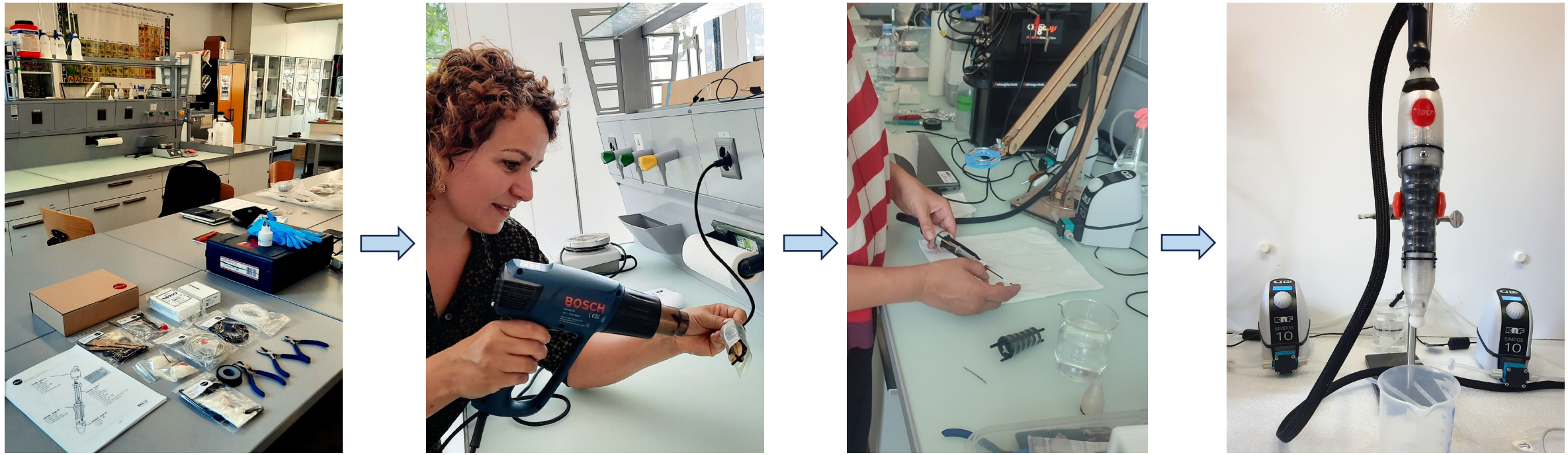
1. Assembling Pleco and shaping the nozzle pads

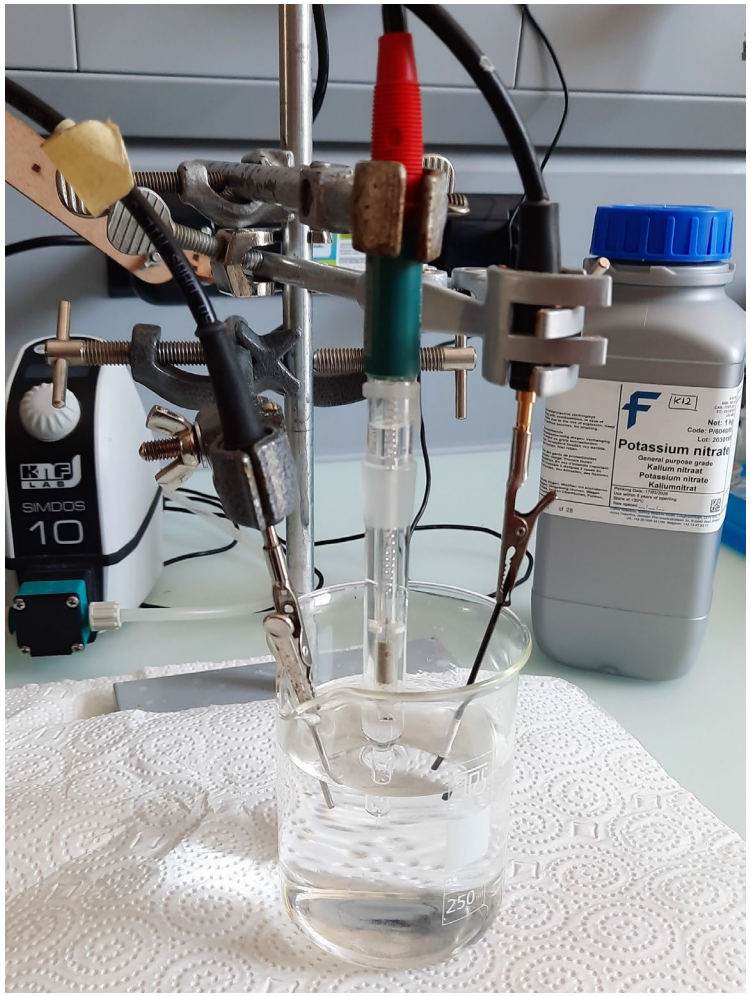


Pleco is a tool designed for local electrolytic analysis and treatment of historical metal.

It is equipped with:

- glassy carbon (GC) electrode by Metrohm® (rod: L 76mm and Ø 2mm) and used as a reference electrode
- 1 platinum counter-electrode (rod: L ~40mm and Ø 2mm)
- AION® clean room sponge D-3 (microporous PVFM foam used to make the nozzle pads)

2. Setting up the Pleco and determining the working parameters



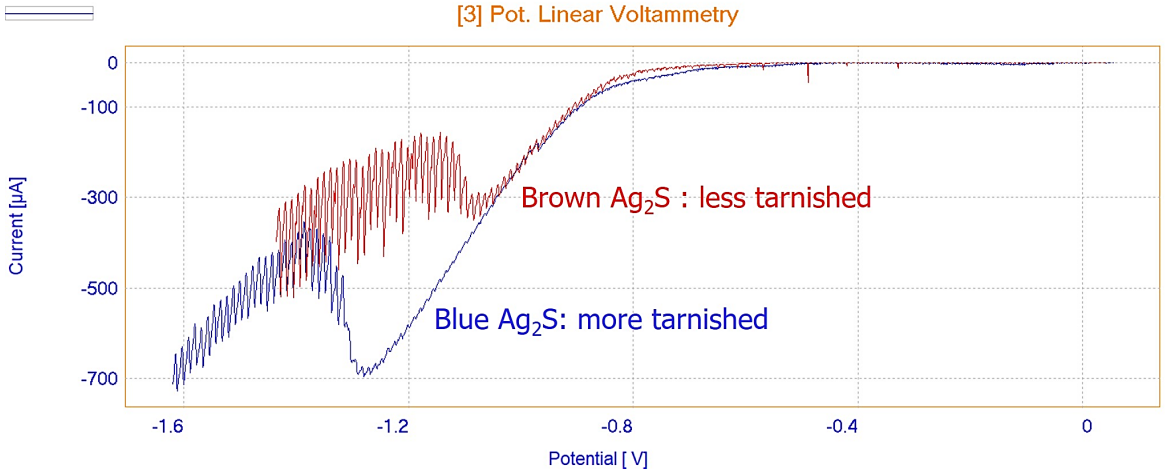
Measurement of the OCP of the GC electrode by placing the Pleco platinum and GC electrodes together with the Ag-AgCl reference electrode (Metrohm®) immersed in 1% (w/v) KNO_3.

⇒ The three electrodes are connected to an *OrigaStat 200* potentiostat, controlled by Origamaster 5 corrosion software.

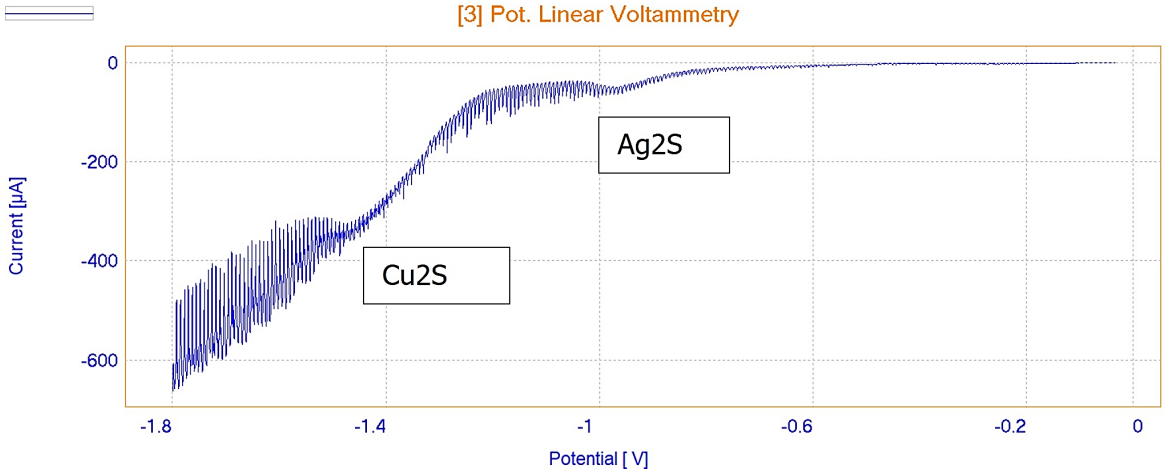
⇒ The Pleco hoses are connected to the two *SIMDOS*® Diaphragm Liquid Dosing Pumps and the electrolyte is primed in the Pleco electrolytic cell.

3. Characterization of artificially tarnished pure silver (Ag999) and sterling silver (Ag925) by LSV

A

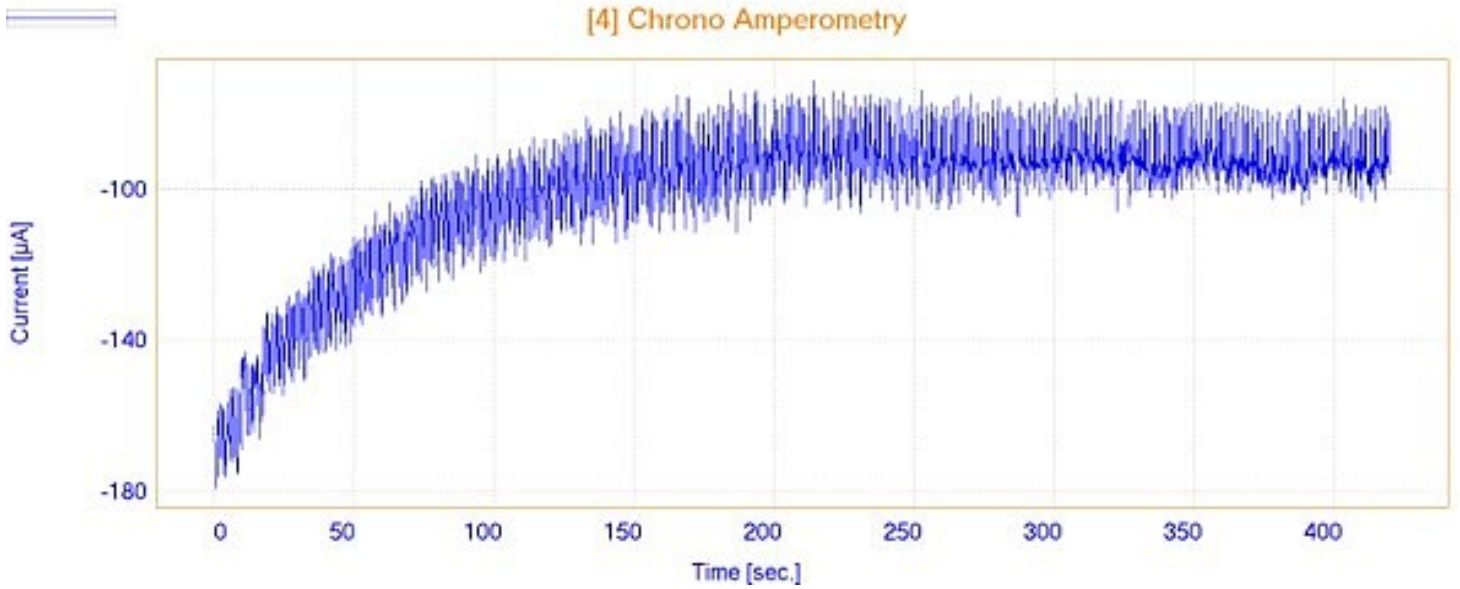


B



⇒ LSVs using Pleco on tarnished Ag999 (A) and Ag925 (B) coupons.

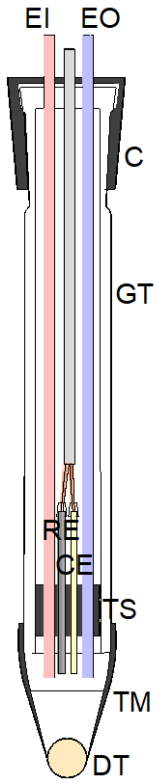
4. Determination of the duration of tarnish degradation by chronoamperometry



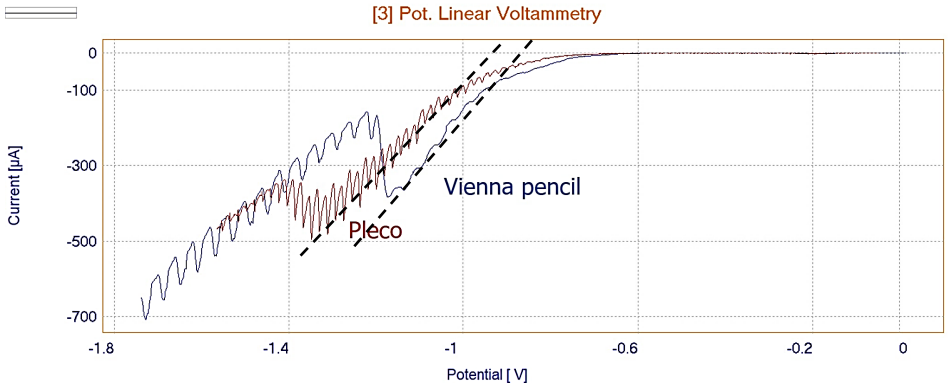
⇒ By means of chronoamperometry it is possible to determine, for a given potential, the duration of tarnish reduction.

⇒ The chronoamperometric plot shows that at a potential of -1.2 V/GC, the cleaning is completed after about 200 seconds (the current is constant).

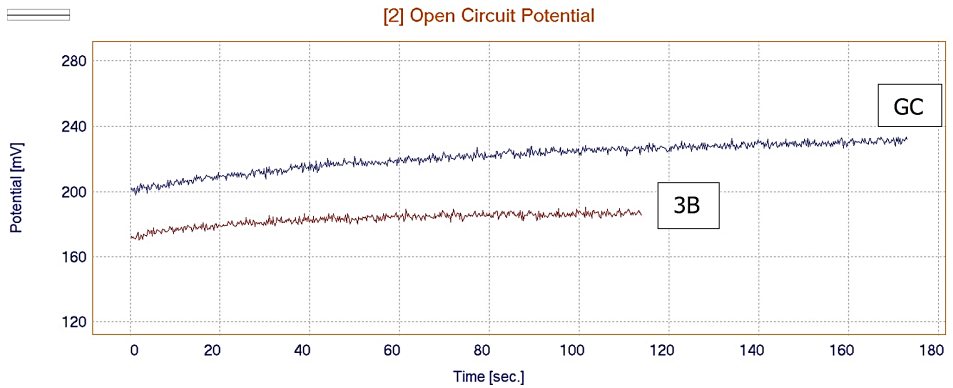
5. Comparison of the two electrolytic pens - newly built Pleco versus Vienna pin



A



B



⇒ LSV measurements on tarnished pure Ag using Vienna pencil in blue and Pleco in red (A); Comparison of OCP for GC and 3B after polarization – the 3B comes back pretty fast to its original potential while it takes longer time for GC (B).

The Vienna electrolytic pencil is operated with a graphite lead as RE and an Au wire coil as CE.
EI/EO: Electrolyte inlet and outlet; C: Cap; GT: Glass tube; TS: Tube sheet; TM: Tip mounting;
DT: Diaphragm tip

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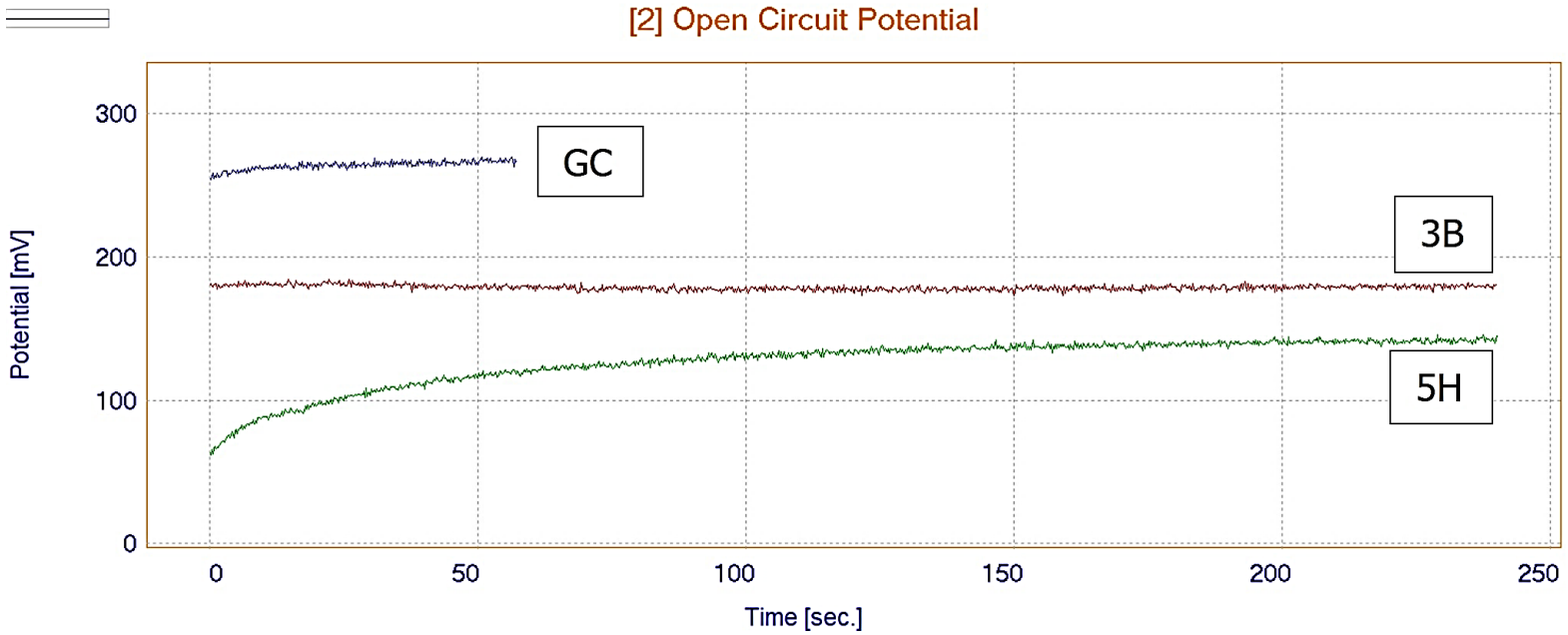
6. Comparison of GC electrode and two different Faber-Castell graphite leads

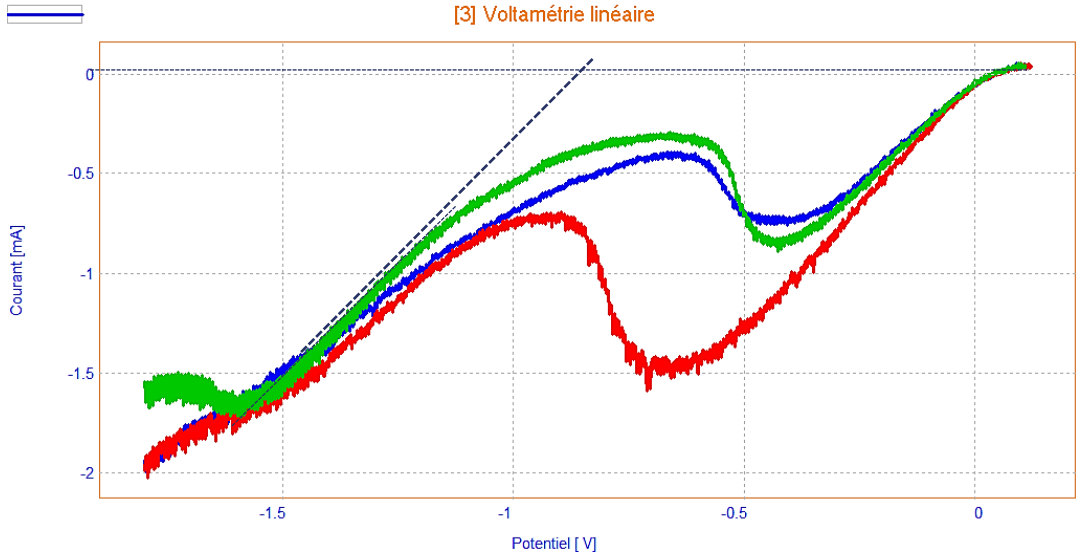


⇒ OCP measurements were carried out with the GC electrode and the 3B and 5H hardness leads in 1%(w/v) KNO_3.

⇒ It was observed that the 3B lead is stable and very comparable to the GC electrode, while the 5H lead required a much longer time to give a stable OCP due to its high clay content

7. Performance of LSV on historical objects with Pleco

Tarnished silver chalice by silversmith Marcel Feuillat (1930-1935, Geneva), © Atelier Abbaye de St Maurice



⇒ Set-up of the chalice during the LSV measurements using Pleco.

⇒ Three LSV plots measured at the base of the chalice showing strong AgCl compounds and Ag_2S.