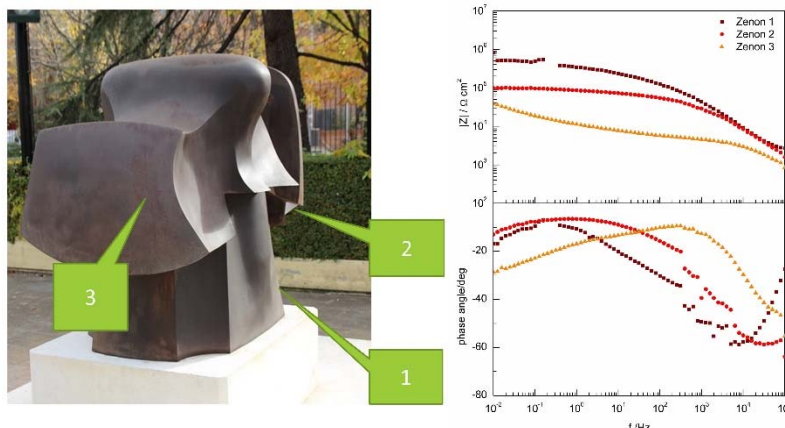


## MOLAB

### METAL.es. In-situ metal electrochemical studies for heritage science

#### Description



METAL.es stands for METAL Electrochemical Studies. It is a mobile laboratory for the in-situ study of the characteristics and behavior of the surface of metallic heritage assets, including natural and artificial patinas and decorative or protective coatings, by means of portable electrochemical techniques. Several conventional or advanced analytical techniques are available in different MOLABs to characterize patinas and coatings, providing information about their physical structure or chemical composition. However, none of them can directly measure the protective properties and corrosion resistance of these patinas and coatings. By means of electrochemical techniques, our system allows to measure the electrochemical behavior of the metal/patina/coating system, obtaining the corrosion (degradation) rate of the object, the effectiveness of patinas and coatings to arrest further deterioration, and its evolution over time. This information is complementary to that obtained by techniques offered by other MOLABs. The uniqueness of the access offer is based on the gel-polymer electrolyte (G-PE) cell developed by the provider, which allows applying these techniques for in-situ measurements on heritage objects; and the expertise of the group in the study of metallic heritage, assuring the respect for the object and a meaningful interpretation of the data in this specific field.

#### Fields of application

##### Cultural heritage

architecture, art, decorative arts, musical instrument, sculpture

#### Materials

##### inorganic

metal and metallurgical By-Products

##### organic

corrosion inhibitors, organic coatings

#### Equipment

The electrochemical system is composed of a portable potentiostat/galvanostat/ZRA (Gamry Ref600, including DDS to perform EIS from 10  $\mu$ Hz to 1 MHz, and floating ground, accuracy of  $\pm 1$  mV and  $\pm 10$  pA) adapted for field operation by means of batteries; a gel polymer electrolyte (G-PE) electrochemical cell, with a 3-electrode configuration and possibility to tailor the selection of electrolyte, specifically developed for non-destructive analysis of cultural heritage assets; and a positioning/supporting system allowing to perform analysis on different geometries, positions (even upside down), surface textures, etc. Different electrochemical techniques can be carried out, such as polarization resistance, polarization curves or electrochemical impedance spectroscopy (EIS). The standard measured area is a circle of 2 cm diameter, but the cell can be adapted to larger or smaller areas if needed.

## Potential Results

The system offered is suitable for the study of metallic heritage, covered by corrosion layers, patinas and/or protective coatings (paints, varnishes, waxes, etc.). The electrochemical response of the system allows to obtain corrosion rates; to quantitative measure the protective properties of the patina/corrosion layer/coating; to compare different protection systems proposed by the conservators-restorers or developed by researchers; to follow up the evolution over time and ageing of these coatings or patinas; and to detect the failure of the protection systems before evident corrosion takes place on the substrate, therefore allowing to apply a new conservation treatment before actual damage occurs to the heritage artefact or monument. The G-PE cell allows to measure in-situ on the objects. It allows to measure in all positions (even upside down), no rough or smooth surfaces, and in flat and slightly curved areas. The electrolyte composition can be tailored to measure corrosion behavior in different scenarios, such as objects exposed to different atmospheres (marine, urban, industrial or rural) or specific compositions for metals of different sensitivity.

## References

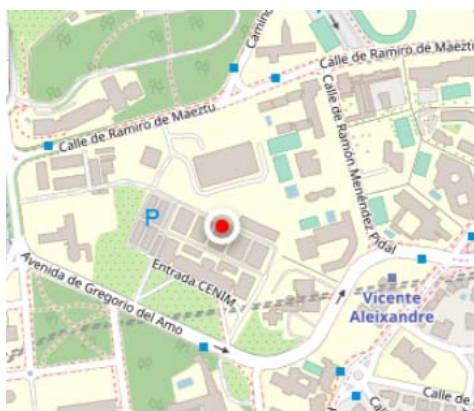
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## Sample or service requisites

- Preparation of multiple cells requires the use of a microwave, that should be available in the user location.
- The equipment can be battery operated, although if possible, connection to the electrical network is preferable.

For further details please contact the provider.

## Provider



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