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A simple Arduino-based EIS system for in situ corrosion monitoring of metallic works of art

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Abstract

Metallic artifacts of archaeological and historical interest, exposed to outdoor environmental conditions, can be affected to a great extent by degradation, due to the presence of aggressive compounds in the surrounding environment.The development of suitable preventive conservation strategies for these important signs of our culture, requires their corrosion behavior to be investigated in order to understand the electrochemical phenomena that occur on the metallic surface. This investigation can easily be performed in a laboratory by means of different chemico-physical techniques, which provide information on the composition, microstructure and morphology of the corrosion products, as well as by means of electrochemical measurements, which allow the corrosion resistance of the metal to be estimated. Unfortunately, these measurements are often invasive and require microsampling. Electrochemical Impedance Spectroscopy (EIS), thanks to the its high degree of sensitivity, and to the small perturbation applied to the corroding system, can be considered a useful non-destructive testing method to obtain valuable information on the conservation state of metallic works of art.

This paper describes an innovative, portable, low-cost and user-friendly solution for EIS in situ measurements, based on the widely diffused Arduino board, and on specifically designed measuring probes. The proposed solution cannot provide the detailed knowledge of the corrosion mechanisms that occur on metallic surface, but it can be an extremely useful tool for conservators and art historians for the assessment and long-time monitoring of the stability of the artifacts.

Keywords: EIS, Metallic artefacts, Corrosion measurement, Cultural Heritage, Portable instrument

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