

# The use of copper and silver plated piezo electric crystals to assess indoor air quality

H.A. Ankersmit [1], S. Watts [2], V. Costa [3]

[1] Department, Netherlands Institute for Cultural Heritage (ICN), Gabriël Metsustraat 8, 1071 EA Amsterdam, the Netherlands.

[2] School of Biological and Molecular Sciences, Oxford Brookes University (OBU), Headington, Oxford, UK

[3] Cercle des Partenaires du Patrimoine, Laboratoire de Recherche des Monuments Historiques (CPP), 29 rue de Paris, 77470 Champs sur Marne, France

[bart.ankersmit@icn.nl](mailto:bart.ankersmit@icn.nl), [sfwatts@brookes.ac.uk](mailto:sfwatts@brookes.ac.uk), [virginia.costa@culture.gouv.fr](mailto:virginia.costa@culture.gouv.fr)

The aim of this research is to establish a relationship between the environmental conditions (particularly atmospheric trace gases) and the degree of corrosion of Cu and Ag. Therefore Piezoelectric Quartz Crystals (PQC), discs which are coated with silver or copper, are exposed to controlled environments containing organic acids or reduced sulfur compounds at ppb levels. Next to the PQC metal coupons were exposed that were analyzed by electrochemical techniques to investigate the corrosion products formed.

## Methods of study

The Piezoelectric Quartz Crystals (PQC) are exposed inside a perspex box which is placed inside an oven ( $T = 23\text{ }^{\circ}\text{C}$ ). Permeation tubes (acetic and formic acid and formaldehyde) are used to create a corrosive environment at the ppb level. Reduced sulfur ( $\text{H}_2\text{S}$  and OCS) environments are typically at high ppt level.

Pollutant concentrations and RH (50%) / T ( $23\text{ }^{\circ}\text{C}$ ) are controlled by flow meters.

## Experimental Results

Thus far the general approach regarding indoor air pollution projects has been *i)* analysis of the degradation phenomena on objects, *ii)* determination of emission of harmful gases from construction materials and *iii)* concentration measurements of individual gases in the museum atmosphere by Palmes diffusion tubes. The use of Palmes diffusion tubes enabled the identification and quantification of individual gases, which could subsequently be linked to possible sources. However, one technique is not sufficient to fully describe the behaviour of a complex metal-environment system. To fully understand the corrosion rate of copper and silver in different polluted environments it is better to link PQC with electrochemical analysis.

After approximately 1 week exposure the frequency changes of the PQC are evaluated. This information can be combined with analysis of the compounds formed on the surface. Together the results will indicate the rate of deterioration for that specific environment. This rate of decay can then be used to determine if preventive measures need to be taken. To get a general notion of typical frequency changes in 'natural environments', real time exposure were performed in different museums throughout the Netherlands. At every museum different locations were monitored. Attention was focussed on both climatized and non-climatized museums.

The conclusions are forthcoming