



## **POSTER: Study on the formation of calcium oxalate on stone materials and on Japanese lacquer**

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There is still debate about the origin of calcium oxalate films, which are one of the main causes of color change of stone materials [1]. The biologic genesis due to oxalic-acid-generating microorganisms has been proposed, as well as the chemical formation of oxalic acid due to the oxidative decay of biological coatings on the stone surface due to past polishing and restoration works with natural materials (lipids, proteins, carbohydrates) [2].

Recent research works [3] showed that oxalate salts could be also the decay product of the Japanese lacquer (urushi), which is a natural polymer obtained from the exudate of the tree *Rhus Verniciflua* and widely used in East-Asian art for the finishing of both wood and metallic surfaces. It is not known if it happens only when lacquer is mixed with organic additives, to obtain different properties [4]. Ancient texts and modern analyses also report the use of calcium carbonate powder as a filler in the lacquer, which can easily explain the availability of calcium ion.

The actual work proposes a systematic assessment of the formation of calcium oxalate salts due to the action of bacteria and fungi on mock-up samples made of marble, gypsum, and lacquered wood which were previously covered or prepared with different organic additives. Half the samples underwent accelerated ageing conditions in order to evaluate the influence of a decayed support on the microbiological growth.

The inocula were respectively the bacterial and fungal consortia previously isolated both from stone materials (bas-relief of the external façade of Pisa Cathedral) and from the lacquered metal plates constituting the traditional Japanese samurai armor (Morigi Collection, Museo delle Culture, Lugano, Switzerland). Both the sampling contexts showed the presence of calcium oxalate. After the inoculation, the mock-up samples underwent high humidity and ambient temperature conditions. The microbial growth was assessed over time through microscopic observation (SEM), while the formation of organic acids and of oxalate salt was monitored by Fourier transform infrared spectroscopy (ATR-FTIR and external reflection-FTIR) and by X-ray diffraction (XRD).

The present work aims to clarify if the oxalate films could be originated from the reaction between microbial metabolic products and air oxidants. This research could shed new light on the formation of the salt, and in particular if it comes from microbial growth alone or if it is the result of the synergy between chemical and biological genesis.

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## ART BIO MATTERS

### Essential Bibliography

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