

Sensors design for preservation purposes

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The objective of this research is to design optical sensors for the detection of the organic compounds formic acid, acetic acid and formaldehyde. A robust sensor will be obtained through the encapsulation of the dyes in sol-gel films. The produced sensors will offer a suitable alternative for detecting the referred compounds without the need for using electrodes, solutions, pH meters or batteries.

Wood and other materials used for the construction of cabinets for museum display and storage of glass objects release organic pollutants such as formic acid, acetic acid and formaldehyde. These volatile organic compounds play an important role on the alteration of the glass structure due to the alkali leaching process. It has been determined that formic acid is the one that affects more the glass integrity, accelerating and deepening the alkali leaching from the silica matrix. As this situation can affect many objects from museum glass collections, monitoring this compound *in situ* would be of great importance for indoor preservation of cultural heritage objects.

Although a new generation of monitoring and analytical devices is currently available to study both indoor and outdoor atmospheric conservation, there are difficulties related to this subject which include a limited access to sophisticated measurement equipment aggravated by the relative high number of places to be monitored and measured (e.g. museum halls, interior showcases and storage boxes). Therefore simple and low-cost devices for detecting the pollutants *in situ* are still required for the preservation of cultural heritage objects.

A new, simple and low-cost, optical sensor for detecting the presence of formic acid was developed and is under testing. The sensors are based on an optical response resulting from the reaction between the referred organic pollutant and immobilised chemo-responsive dyes in polymeric structures, produced with layer-by-layer (LbL) electrostatic self-assembly process. Results on performance, reversibility and reproducibility of the sensors are still under study. This sensor was already tested on performance, reversibility and reproducibility (by means of UV-Vis spectroscopy). The detection limits of the sensor are currently being determined with the help of HPLC.

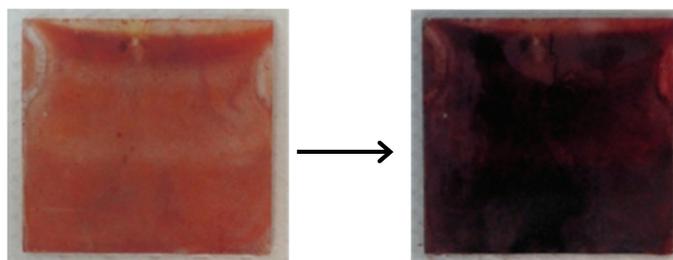


Figure 1 – LbL sensor before and after being exposed to vapors of formic acid.

Communications

(Poster) Inês Coutinho, Márcia Ventura, Márcia Vilarigues, Jorge Parola, "A new and simple optical sensor for the detection of formic acid unleashed by wooden storage or display materials used in museums and responsible for accelerating glass deterioration" in *Recent Advances in Glass, Stained Glass and Ceramics Conservation* ICOM-CC Glass and Ceramics Working Group Interim Meeting and

Forum of the International Scientific Committee for the Conservation of Stained Glass (Corpus Vitrearum-ICOMOS), Amsterdam, The Netherlands, 7-10 October 2013.

(Poster) Inês Coutinho, Márcia Ventura, Márcia Vilarigues, A. Jorge Parola. "Optical sensor for the formic acid detection prepared through the immobilization of colorimetric dyes in a polymeric matrix assembled by the layer-by-layer method", 2nd International Conference in Chemistry for Cultural Heritage, Istanbul, Turquia, 9-12 Junho 2012.

Ongoing PhD Thesis:

Inês Coutinho, PhD in Conservation and Restoration, FCT/UNL, "A new inside on the 17th and 18th century Portuguese glass collections: study and preservation" (SFRH/BD/72552/2010).

