



TechnoHeritage



Real Sociedad Española de Química



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## BOOK OF ABSTRACTS

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# A new perspective on the study of microenvironments created by the backings on canvas paintings: use of environmental pH sensors

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Currently, backings are widely used as a preventive conservation treatment for paintings on canvas [1]. However, this kind of intervention promotes the accumulation of pollutants, which could be a risk to the chemical stability of the painting. Right now, the scientific research into this problem is limited [2]. The main objective of our research is to use optical pH sensors to evaluate how the presence of pollutants and their interactions affect the air chamber's characteristics. These were patented (P201003107) by the research group CERVITRUM (CSIC), and, at present, are the only technology capable of effectively measuring the pH of the air quantitatively and qualitatively [3].

The application of sensors in our research project was carried out through an experimental study where we worked with 15 mock-ups in which different backing materials were placed. These were exposed to variations in RH and T that simulated an exhibition space without climate control. The main point of the workplan was to adapt the usual evaluation methodology of the sensors since, due to the characteristics of microspace, this cannot be followed. First, we tested different exposure times, and, after establishing the most suitable one for the objectives set, we made multiple evaluations to check its reproducibility throughout the 7 months of study.

The results obtained have shown differences in the environmental pH that vary according to the material used as a backing. We detected variations of 0.1 units on the pH scale between paper, plastic sheets and boards derived from wood. This data has been repeated in the continuous measurements of each model. Therefore, the development of this project has allowed us to apply the environmental pH sensor as a quick, simple and efficient way to evaluate the impact of the accumulation of polluting gases behind a canvas closed with a backing. Compared to conventional analysis procedures, the major advantage of this new methodology is to determine the characteristics of the air chamber from a general perspective in which all its parts interact.

## Acknowledgements:

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## References:

- [1] L. Elkin, C.A. Norris (Eds.), *Preventive conservation: Collection storage*. Society for the Preservation of Natural History Collections, 2019.
- [2] S. Hackney, Colour measurement of acid-detector strips for the quantification of volatile organic acids in storage conditions. *Studies in Conservation*, 61 (1), 2016, 55-69.
- [3] J. Peña-Poza, *Optimización, comportamiento y preindustrialización de sensores ambientales basados en la tecnología sol-gel*. Universidad Autónoma de Madrid, 2014.

# A new perspective on the study of microenvironments created by the backings on canvas paintings: use of environmental pH sensors

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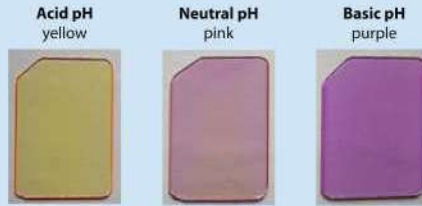


## POLLUTING GASES DUE TO BACKINGS

Currently, backings are widely used as a preventive conservation treatment for paintings on canvas [1]. However, this kind of intervention promotes the accumulation of pollutants, which could be a risk to the chemical stability of the painting. Right now, the scientific research into this problem is limited [2].

## THE ENVIRONMENTAL pH SENSORS

These were patented (P201003107) by the research group CERVITRUM (CSIC), and, at present, are the **only technology capable of effectively measuring the pH of the air quantitatively and qualitatively** [3]. The sensors are based on sol-gel technology that creates a sensitive coating capable of emitting a signal (**change of color**) to any substance that interacts with the reagent.



**QUALITIES**  
Detect pH changes of up to 0.1 pH units  
Fast response time  
In-situ measurement

**APPLICATIONS**  
Museums, palaces, libraries, churches and interior of display cases



## Step 1

### BACKING MODELS

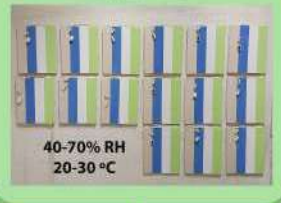
Selection of backing materials according to different documentary sources

N	BACKING MATERIALS
1	Polyester fabric, Trevira® (Ljpa®)
2	Polyethylene nonwoven fabric, Tyvek® (6222)
3	Meltranylata sheet
4	Polypropylene sheet
5	Polycarbonate sheet, Lexan®
6	Linear fabric
7	Millboard
8	Acid-free corrugated board, Scheerpp®
9	Acid-free foamboard, Fome-Cor®
10	High-density wood fiberboard, Kronospan®
11	High-density wood fiberboard (perforated) Motex®
12	Plywood board, Sallmer®
13	Phenolic okume plywood board, Sallmer®
14	Glass (control model)
15	Without backing (control model)



## Step 2

### IRREGULAR ENVIRONMENTAL CONDITIONS



## Step 3

### SUITABILITY OF THE USE OF THE SENSORS TO OUR GOALS

The use of the sensors should not modify the characteristics of the microclimate, so it is not possible to apply the usual methodology (recording the signal of the sensors progressively for about 10 days)

In this case the most appropriate use of the sensors is to compare the initial measurement of pH and absorbance with the final one. But for this purpose it is necessary to find an appropriate continuous exposure time.



Environmental pH sensor and thermohygrometer



Positioning and removal of the sensor from the edge of the model

## EXPERIMENTAL TEST WITH MODELS

Apply the optical pH sensors to evaluate how the presence of different pollutants and their interactions affect the air chamber's characteristics

## RESULTS OF EXPERIMENTAL TEST

## CONCLUSIONS

The results obtained have shown differences in the environmental pH that vary according to the material used as a backing. We detected variations of 0.1 units on the pH scale between paper and boards derived from wood. This data has been repeated in the continuous measurements of each model.

The development of this project has allowed us to apply the environmental pH sensor as a quick, simple and efficient way to evaluate the impact of the accumulation of polluting gases behind a canvas closed with a backing.

## Test 1: 10 days exposure

Model	Initial absorbance	Initial pH	Final absorbance	Final pH	RH % Inside	T °C Inside
3	0.1589	7.5	0.1594	7.5	72	22.1
4	0.1434	7.5	0.1517	8.3	55	20.3
5	0.1514	7.5	0.1588	8.9	76	21.1
6	0.1316	7.5	0.1424	8.9	57	19.9
7	0.1525	7.3	0.1575	7.5	74	22.0
8	0.1361	7.4	0.1417	7.5	55	20.0
9	0.1601	7.4	0.1617	7.9	70	22.3
10	0.1387	7.4	0.1436	7.9	59	20.9
11	0.1697	7.5	0.1762	7.9	76	21.5
12	0.1492	7.5	0.1666	8.4	60	19.4
13	0.1622	7.2	0.1733	7.7	73	22.1
14	0.1484	7.2	0.1613	7.9	60	19.8
15	0.1562	7.5	0.1665	7.1	70	21.5
16	0.1470	7.5	0.1358	6.7	52	20.6
17	0.1725	7.4	0.1548	7.1	68	21.7
18	0.1539	7.8	0.1334	6.7	54	20.1
19	0.1618	7.6	0.1556	7.3	70	22.1
20	0.1461	7.6	0.1433	7.4	54	20.6
21	0.1660	7.4	0.1870	7.5	69	22.3
22	0.1491	7.9	0.1264	7.7	57	20.7

The results obtained were not in agreement with those expected. The values recorded in some models (red) were very high. This phenomenon is associated with the stabilization of the reagent which tends to a more basic pH [3].

## Test 2: 4 days exposure

Model	Initial absorbance	Initial pH	Final absorbance	Final pH	RH % Inside	T °C Inside	Δ pH	Δ Absorbance
3	0.1592	7.0	0.1670	7.0	71	22.1	0.0	-0.078
4	0.1633	7.0	0.1642	7.0	49	21.3	0.0	-0.009
5	0.1616	6.6	0.1687	7.0	66	24.1	+0.1	-0.068
6	0.1636	7.0	0.1608	7.0	55	22.3	0.0	0.0028
7	0.1537	6.2	0.1566	7.0	53	22.1	+0.1	-0.0068
8	0.1600	6.8	0.1662	6.8	60	20.6	0.0	-0.0064
9	0.1624	6.6	0.1661	7.0	41	26.0	+0.1	-0.0037
10	0.1624	6.6	0.1661	7.0	52	24.0	0.0	0.0037
11	0.1574	7.0	0.1681	6.8	49	23.9	0.2	0.0108
12	0.1616	6.6	0.1626	6.8	40	21.2	0.1	0.0010
13	0.1626	7.0	0.1639	6.9	57	24.7	0.1	0.0013
14	0.1626	7.4	0.1661	6.8	33	22.8	0.4	0.0035
15	0.1620	6.9	0.1607	6.8	61	23.4	0.0	0.0013
16	0.1620	6.9	0.1662	7.1	38	26.9	0.0	-0.0042
17	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050
18	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050
19	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050
20	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050
21	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050
22	0.1626	6.9	0.1676	6.8	43	26.9	0.0	-0.0050

The results obtained are following expectations. By reducing the sensor's exposure time, stabilization of the reagent is avoided. The measurements were repeated for 7 months to corroborate their repeatability.

## REFERENCES

- [1] L. Bikan, C.A. Norris (Eds.), Preventive conservation: Collector storage. Society for the Preservation of Natural History Collections, 2016.
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- [3] J. Peris-Pérez, Optimización, comportamiento y preindustrialización de sensores ambientales basados en la tecnología sol-gel. Universidad Autónoma de Madrid, 2014.

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