Actividades divulgación Proyecto AGROALNEXT_2024

Lugar	XI International Congress on Analytical Nanoscience and Nanotechnology (NyNa 2024) del 3 al 6 de septiembre de 2024 en Santiago de Compostela, Galicia. Presentación tipo posters. Libro de resúmenes
Localidad	Santiago de Compostela
Provincia	
Fecha	3-6 de septiembre 2024
Proyecto:	Sensor económico y eficiente para el control del amoniaco en explotaciones ganaderas: NH3ControlFarm
Código proyecto	AGROALNEXT_2022/19
Grupo de investigación	VNIVERSITAT DE VALÈNCIA · MINTOTA GRUPO DE INVESTIGACIÓN Departament Química Analítica

INFORME DE LA ACTIVIDAD: Difusion del proyecto en congreso internacional

FOTOS DE LA ACTIVIDAD: Posters

NH3ControlFarm, solid sensor doped with SiO_2 nanoparticles: confirmation studies of its response for the determination of ammonia in farms

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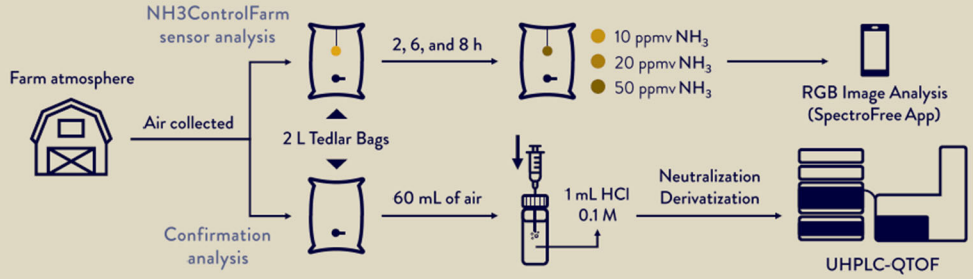
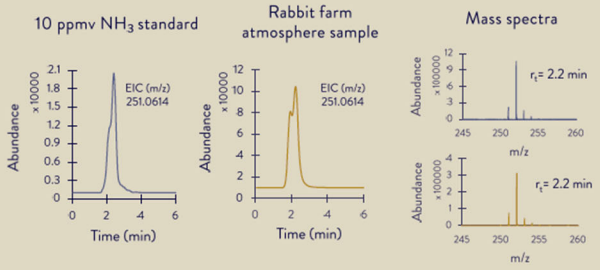
Introduction

The NH3ControlFarm is a colorimetric solid sensor patented by the MINTOTA-UV research group [1]. The sensor is based on a PDMS and TEOS composite doped with SiO_2 nanoparticles, using NQS as derivatizing agent and an ionic liquid. The presence of NH_3 in the atmosphere produces a shift in the colour in the sensor which can be measured by RGB Image Analysis using the SpectroFree App obtaining the NH_3 concentration. The results provided by the SpectroFree App were compared to those obtained by an UHPLC-QTOF prior NH_3 derivatization with dansyl chloride. The aim of this work is to demonstrate the accuracy of the obtained results for its purpose.

Methodology



Results and discussion



Instrument	Working range (ppmv)	y-intercept	Slope ($ppmv^{-1}$)	R^2	LOQ (ppmv)
SpectroFree App	3 – 50	n.a.	n.a.	n.a.	3
UHPLC-QTOF	0.05 – 50	-0.78 ± 0.04	44.5 ± 0.5	0.9998	0.05

Analysis of farm atmospheres

NH_3 quantification in poultry (A and B) and rabbit (C and D) farms. The results were comparable with Er < 10 % in all cases.

Sample	NH_3 found concentration (ppmv)	
	SpectroFree App	UHPLC-QTOF
Farm A	3.71	3.81
Farm B	2.50	2.66
Farm C	6.72	6.63
Farm D	8.20	8.68

Conclusion

Four farm atmosphere samples (two from poultry farms and two from rabbit farms) were collected and analysed by RGB Image Analysis (SpectraFree App) and UHPLC-QTOF prior derivatization. Both methodologies provided similar results (Er < 10 %) with concentrations ranging from 2 to 10 ppmv. This work demonstrates the effectiveness of the sensor for animal farm NH_3 monitoring.

References

[1] PATENT inventors: P. Campíns, Y.Moliner, R. Herráez, C. Molins, J. Verdú, N. Jornet. Title: Passive device for in situ detection and/or determination of amines in gases. Grant no: ES2519891B1. Appl. no: P201300436. Titular Entity: 273 UVEG. PCT: PCT/ES2014/000077 ted 2020), EP 14795283.2. Extended Patent: Dispositivo pasivo para la detección y/o determinación in situ de amoniaco en gases. Grant no: ES2619356B1. Appl. no: P201600032 (granted 08.01.2018). (gran

Acknowledgments

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Study of the influence of silica nanoparticles on NQS-doped PDMS-based sensors

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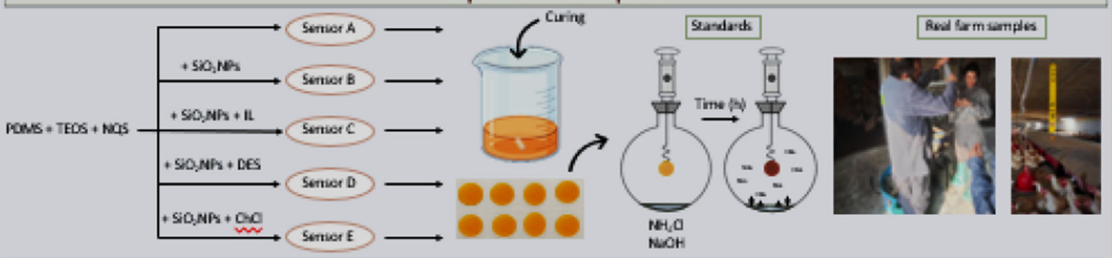
MINTOTA

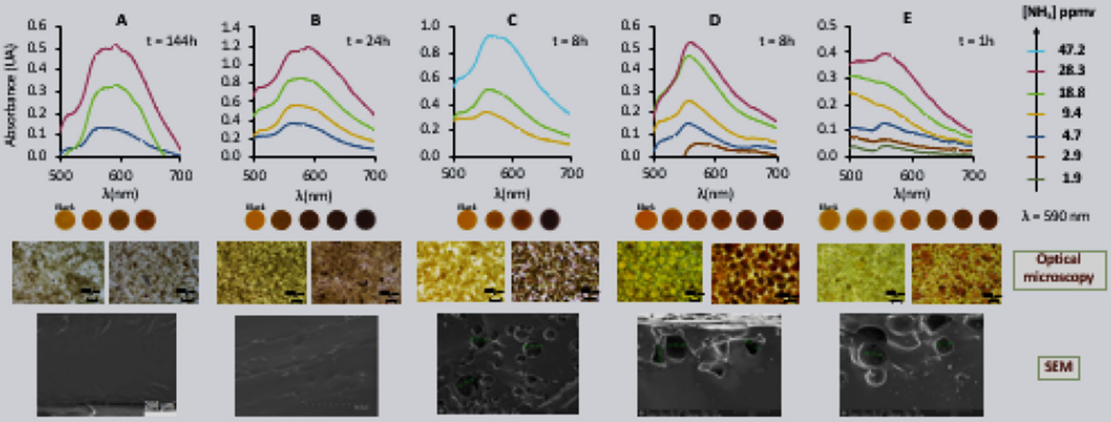
Introduction

Ammonia (NH_3), yet common in nature, in concentrated form can have strong negative impact in animal farms, in particular in the poultry industry with adverse effects on birds' health, growth rate, immune system and intestinal histomorphology. Additionally, the release of NH_3 in the environment is a cause of acid rain, acting as catalyst. The Council Directive 2007/43/EC states that the NH_3 concentration should not exceed 20ppm-v over any eight-hour period or 35ppm-v over any ten-minute period during the poultry production cycle. Passive sensors with different compositions that allow ammonia determination in several atmospheres, requiring zero energy cost and having no toxicity have been developed by MINTOTA[1,2]. This work presents new composites based on polydimethylsiloxane (PDMS) and tetraethyl orthosilicate (TEOS) with sodium salt of 1,2-naphthoquinone-4-sulfonic acid (NQS) as an embedded reagent. The influence of silica nanoparticles (SiO_2NPs) present in the synthesis of these sensors combined with different compounds such as ionic liquid (IL) and new compositions including deep eutectic solvent (DES) and choline chloride (ChCl) were discussed.

Experimental description



Results and discussion



Sensor	t (h)	Linearity $[NH_3]$ ppmv				LOD
		$b \pm S_b$	$a \pm S_a$	R^2	Linear interval $[NH_3]$ ppmv	$[NH_3]$ ppmv
A	144	0.015 ± 0.001	0.07 ± 0.03	0.98	3.0 – 28.3	1.0
B	24	0.038 ± 0.004	0.19 ± 0.01	0.97	1.3 – 28.3	0.4
C	8	0.020 ± 0.002	0.09 ± 0.06	0.98	3.0 – 47.2	1.0
D	8	0.0173 ± 0.0009	0.093 ± 0.012	0.99	2.9 – 28.3	1.0
E	1	0.0121 ± 0.0006	0.052 ± 0.009	0.99	1.9 – 28.3	1.0

Sample	$[NH_3]$ ppmv			
	Sensor B	Sensor C	Sensor D	Sensor E
S1	2.5	3.2	2.2	3.0
S2	4.5	3.6	4.5	3.8
S3	4.0	3.2	4.5	3.0
S4	4.5	4.2	4.0	5.2

Conclusions

Different responses were obtained for each type of nanoparticle chemosensor depending on the combination of the nanoparticles with the compounds present in each type of composite. It was observed that the presence of SiO_2NPs in the sensor increases the sensitivity with respect to their absence. The combination of these nanoparticles with IL and DES reduces the exposure times up to 8 hours and their combination with ChCl reduces it up to 1 hour for obtaining similar signals. Therefore, it was concluded that the presence of silica nanoparticles in combination with these compounds in the composite increases the surface/volume ratio, the porosity, as observed by microscopy, and the sensitivity of the sensor for the determination of ammonia. This performance aid to develop sampling plans in poultry farms in function of the atmosphere to control obtaining similar results with all types of sensors with SiO_2NPs at different sampling times.

Acknowledgements

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Financiado por la Unión Europea NextGenerationEU
GENERALITAT VALENCIANA

References

[1] PATENT inventors: P. Campíns, et al. [illegible]
[2] Extended Patent: [illegible] (granted 08.01.2018).

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