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BIOSENSORS FOR PANDEMICS

ANTIBODY-GATED INDICATOR RELEASING MESOPOROUS MATERIALS: A POTENTIAL BIOSENSOR PLATFORM TO BE USED IN THE DEVELOPMENT OF RAPID TESTS

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Motivation

Keeping in mind the high sensitivity offered by gated indicator-releasing micro- and nanoparticles due to their inherent features of signal amplification, we embarked on system optimisation to develop a potential biosensor platform for use in rapid tests. Here, the insecticide permethrin, a type-I pyrethroid, was selected as target analyte, because type-I pyrethroids play an important role in airplane disinfection.

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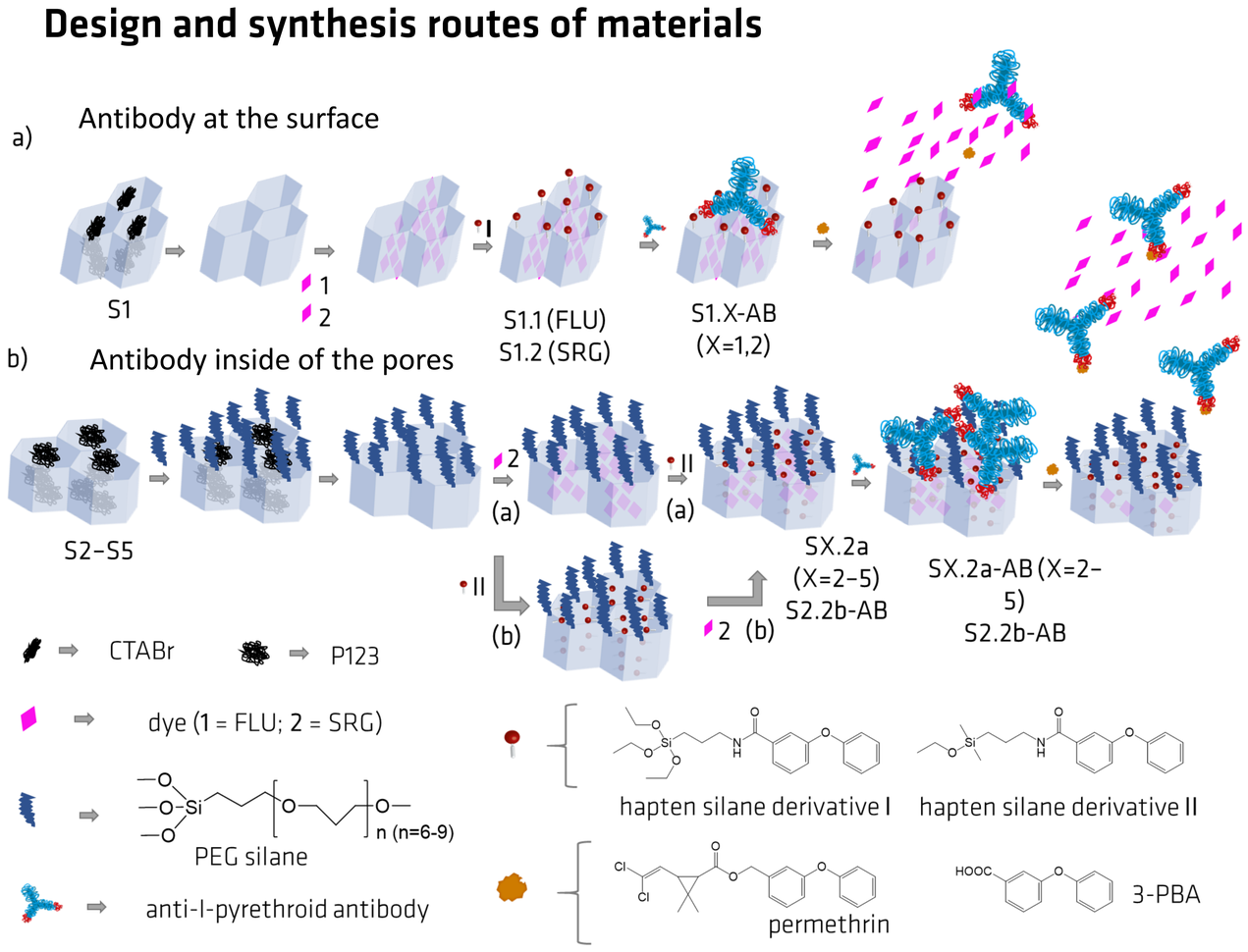
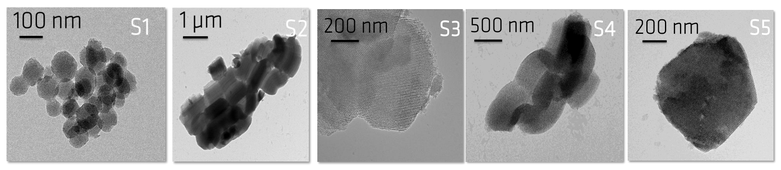
Design and synthesis routes of materials

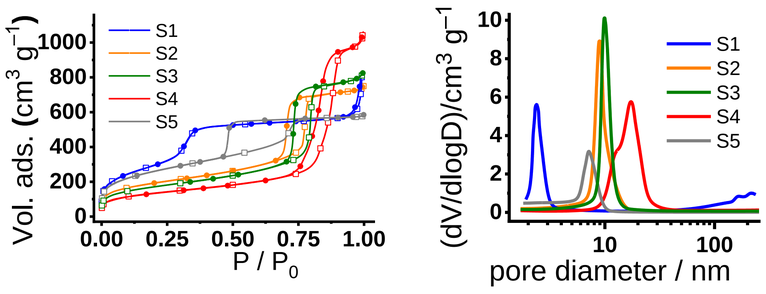


Materials characterisation

Transmission electron microscopy (TEM)



N_2 Adsorption/desorption isotherms and pore size distribution



Elemental (EA) and thermogravimetric (TGA) analysis

	EA					TGA
	FLU %	SRG %	HAPTEN %	PEG %	TOTAL %	TOTAL %
S1.1	6.6	–	2.0	–	8.6	9.4
S1.2	–	29.4	2.0	–	31.3	29.6
S2.2a	–	15.0	1.7	15.2	31.9	30.8
S2.2b	–	17.0	3.2	14.8	35.0	34.3
S3.2a	–	12.3	1.6	17.6	30.2	30.0
S4.2a	–	21.4	2.2	11.1	34.7	31.3
S5.2a	–	16.7	3.5	10.2	30.4	29.3

Response in solution

1.- Analytical assay optimisation with S1.1-AB (FLU as dye)

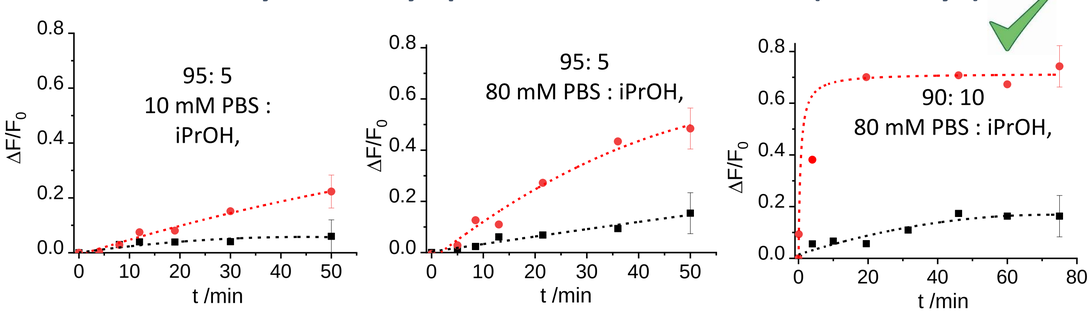


Fig. 1 Increase in fluorescence at 522 nm (λ_{exc} = 490 nm) in the presence (red) and the absence (black) of permethrin (6.6 mg kg^{-1}) of the supernatants of **S1.1-AB** suspensions.

2.- Evaluation of pore size and different loading routes followed using SRG as dye

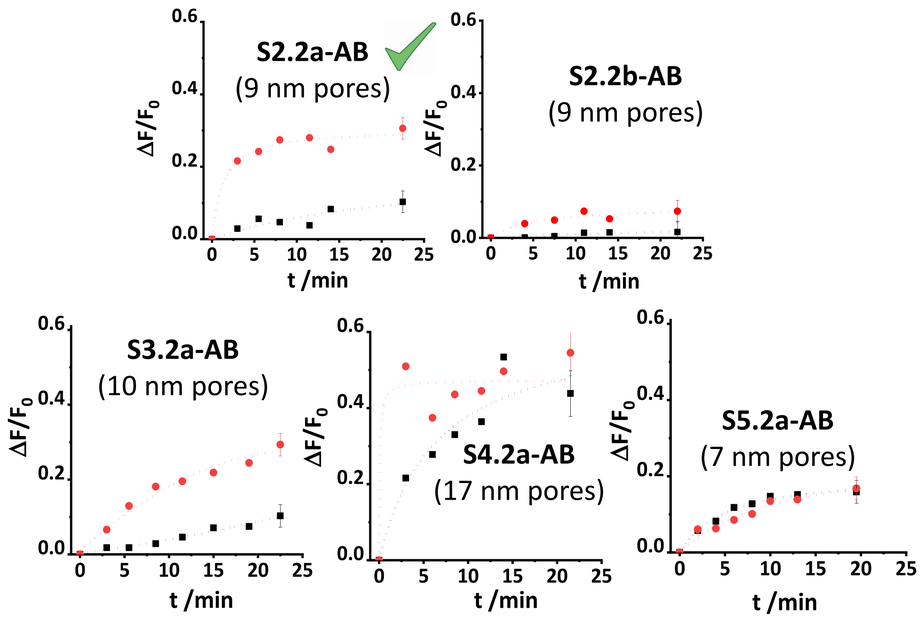
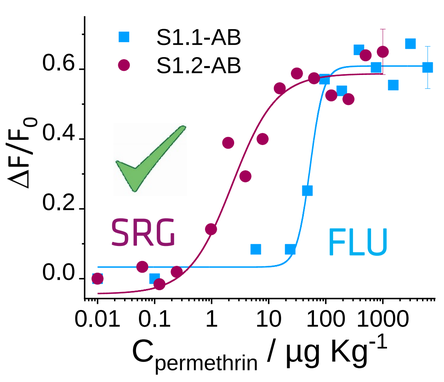


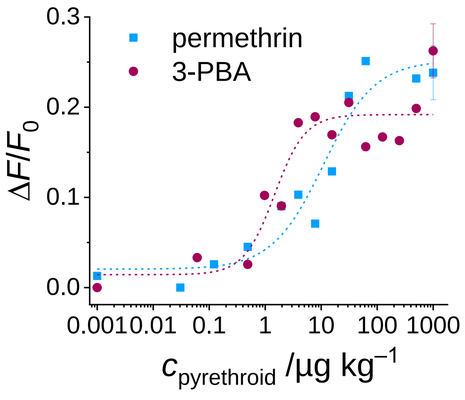
Fig. 2 Increase in fluorescence at 550 nm (λ_{exc} = 532 nm) in the presence (red) and the absence (black) of 3-PBA (0.5 mg kg^{-1}) of the supernatants of **S1.1-AB** suspensions.

3.- Concentration-dependent studies (after 5 min of reaction)

Antibody at the surface (with different dyes)



Antibody inside of the pores (S2.2a-AB) Similar sensitivity

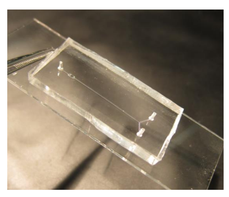


Signal amplification factor

Solid	$C_{10\%}$ µg Kg^{-1}	AF
S1.1-AB	13	2.5
S1.2-AB	1	860
S2.2a-AB	2.5	1010
S2.2b-AB	4	197
S3.2-AB	4	12
S4.2-AB	-	-
S5.2-AB	-	-

Incorporation into different sensing platforms

Microfluidic chips



Paper-based assays

Dip-stick

Lateral flow

Conclusions

- ✓ Increase in ionic strength and presence of organic solvents accelerates release kinetics
- ✓ Indicator dye is decisive for the sensitivity
- ✓ Better material response is observed when size of Fab region of the antibody is similar to the pore diameter and hapten is grafted at the entrance of the pores

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