PhD Open Days

Non-toxic coatings for biofouling prevention on structured materials

PhD in Chemistry in Faculdade de Ciências, Universidade de Lisboa (CQB)

under CATSUS Programme

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Introduction

The unwanted spontaneous colonization by aquatic organisms on surfaces in contact with water forms the so-called Biofouling, causing serious environmental/economic penalties and health risks on several applications (e.g. water circuits, desalination systems) [1,2]. This work aims to develop a new non-toxic solution able to control this phenomenon on surfaces by providing new functional active agents (e.g. biocidal agents) capable of being tethered in polymeric coatings, by following a new functionalization process [3].

Immobilization of the functionalized biocide

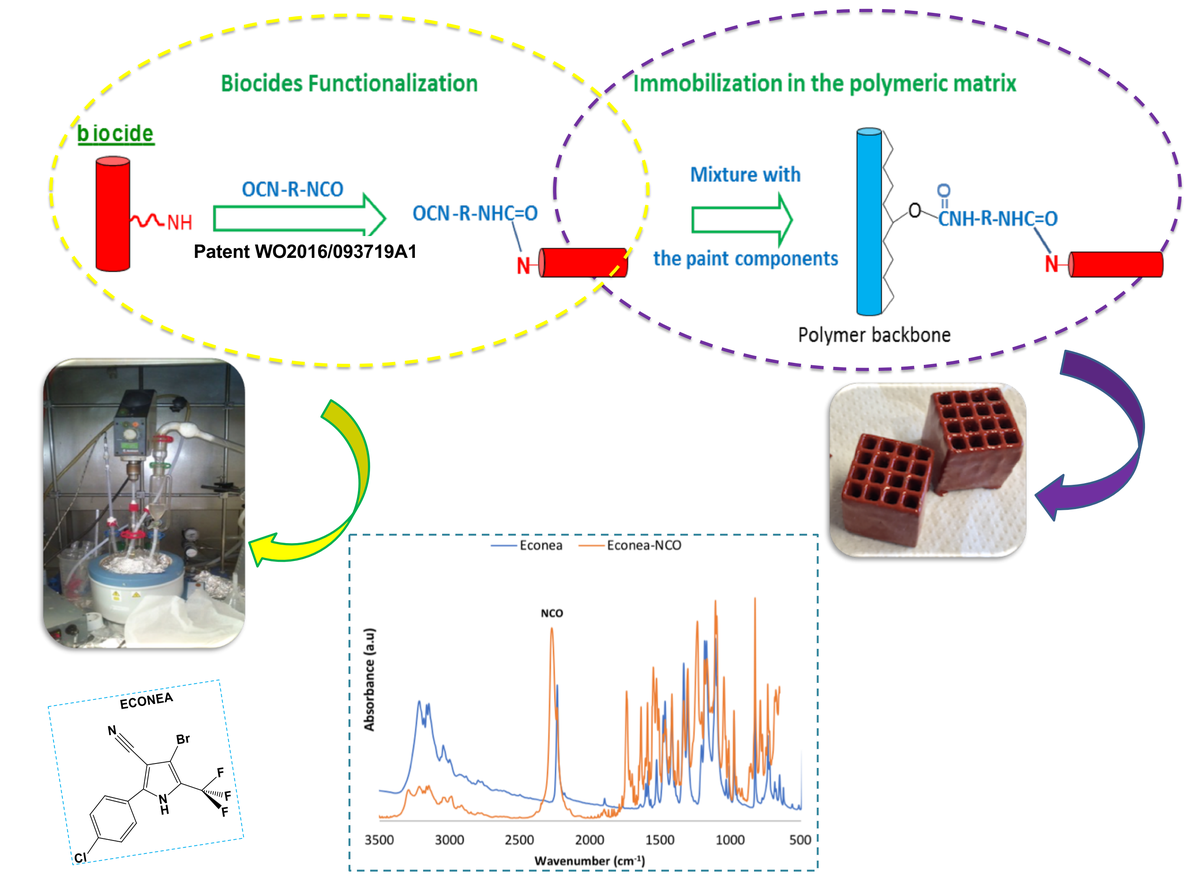
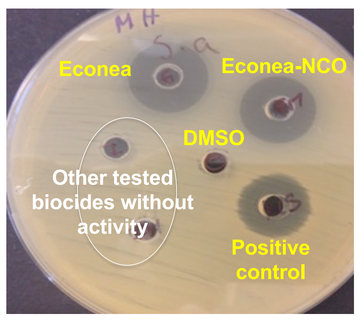


Figure 1: FTIR and NMR spectra of biocidal agent and it's functionalized counterpart

- ✓ FTIR and NMR analysis proved the functionalization effectiveness and preservation of the main biocide structure.
- ✓ **Functionalization of the biocidal agents was confirmed.**

Bioactivity assessment for functionalized biocides



Well Diffusion Method for *Staphylococcus aureus*

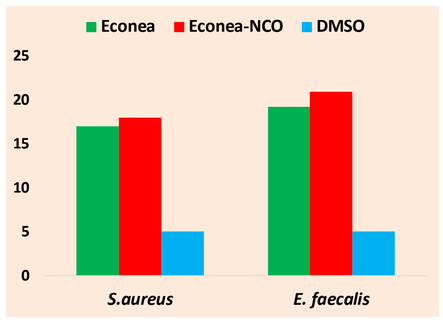


Figure 2: Bioactivity of biocides against different microorganisms

- ✓ **Similar Minimal Inhibitory Concentration (MIC)** for Econea and Econea-NCO: 3,91 µg/mL for the *Staphylococcus aureus* and *Enterococcus faecalis* bacteria

Proof-of-concept

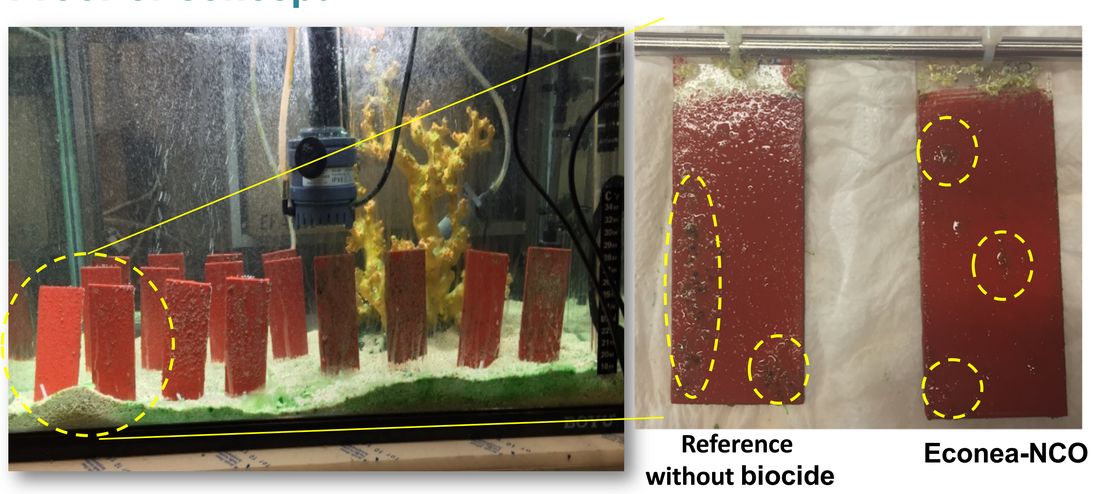
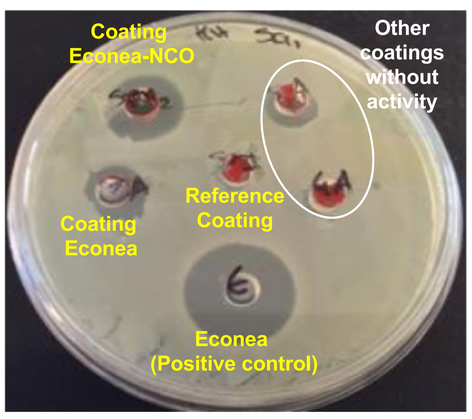


Figure 3: Polyurethane coatings with tethered biocide (3-6 wt. %) on acrylic substrates, after 8 months in an artificial sea water aquarium.

- ✓ Antifouling effect improvements were obtained for coatings containing tethered Econea (3 to 6 wt.%).

Bioactivity assessment of coatings

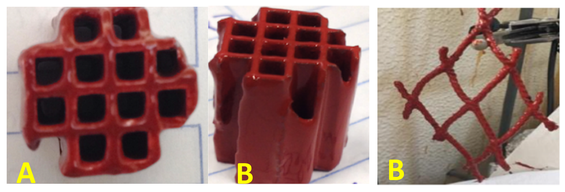


Well Diffusion Method for silicone coatings *Staphylococcus aureus*

- ✓ **Higher antimicrobial activity for coatings with tethered biocide**, which is in accordance with the obtained antifouling behavior (proof-of-concept)

Different supports coated with bioactive paints

Biocidal polyurethane (A) and silicone (B) based coatings.



The original paint properties were not significantly affected.

Conclusions

- ✓ **Commercial biocides were successfully immobilized in polymeric coatings and used to coat different structured substrates.**
- ✓ **Different supports coated with the biocide based paint films, evidenced uniform polymeric coating. Adhesion tests are on-going.**
- ✓ **This approach is presented as a promising non-toxic antifouling strategy.**

Acknowledgements

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References

[1] M. Lejars, A. Margaillan, C. Bressy. *Chemical Reviews.* 2012, (112) 4347-4390.

[2] E. R. Silva, O. Ferreira, J. C. Bordado. *Journal of the Adhesion Society of Japan.* 2015, (51) 239-240.

[3] E. R. Silva, O. Ferreira, J. C. Bordado, Patent Application, WO2016/093719 A1, 2016.

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