Development and optimization of N-halamine coatings based on polydopamine for antibacterial applications

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The fight against the adhesion and proliferation of bacteria on surfaces is a constant concern and a major medical and socio-economic issue for our society. In the medical and food industry, bacterial contamination of surfaces is responsible for many nosocomial and food infections. In addition, this biocontamination of the surfaces may also lead to deterioration of the structural and functional properties of the materials. These biodegradations can indeed lead to corrosion phenomena that can be found in the maritime sector. Thus, preventing bacterial adhesion appears essential and results in the development of antibacterial coatings.

This thesis project aims to develop a new regenerable antibacterial coating in the fight against the formation of bacterial biofilms. Two systems have been studied for this, a system composed of a polydopamine coating (PDA-O_2) and a second system which will present a Polydopamine Polyethylenimine (PDA-PEI) composite, both containing haloamine functions, amine-chlorine bonds (N-Cl). The latter indeed act as an antibacterial agent thanks to the + I degree of oxidation of halogen, giving them a strong oxidizing power. The major stake of this project therefore consists in functionalizing a surface of a PDA and PDA-PEI coating followed by halogenation of the latter to create the haloamine functions at a concentration sufficient to guarantee the antibacterial effect while maintaining the integrity of the coating.

The antibacterial properties were finally evaluated by microbiological tests. We show that these systems can be used to develop biocidal coatings against Gram negative bacterium and against Gram-positive strain, thus demonstrating the broad spectrum of activity of these coatings. Indeed, after exposure to N-chloramine coatings, all these bacterial strains show a significant reduction in adhesion and viability but also exhibit a bacteriostatic effect, namely a reduction in bacterial growth. The present work also highlights an antibacterial activity of non-chlorinated coatings due to PDA. In view of the results, it appears that the PDA-PEI-Cl coating exhibits the best antibacterial response to the two types of bacterial strain tested in terms of anti-adhesion, bactericidal and bacteriostatic properties.

A New Antibacterial N-Halamine Coating Based on Polydopamine. *Nadia Nazi, Vincent Humblot, and Catherine Debiemme-Chouvy. Langmuir* ***2020*** *36 (37).*

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