A ROBUST ANTIBACTERIAL COATING FOR STAINLESS STEEL

Emilie Faure[1], Aurélia Charlot[1,2], Valérie Sciannaméa[1], Sandrine Lenoir[1], Robert Jérôme[1], Christine Jérôme[1], Cécile Van De Weerdt[3], Joseph Martial[3], Catherine Archambeau[4], Nicolas Willet[5], Anne-Sophie Duwez[5], Charles-André Fustin[6], Christelle Vreuls[3], Germaine Zocchi[3], Fabrice Farina[4], Hélène Vandegaart[4], Geoffrey Garitte[3], Caroline De bona[1] and Christophe Detrembleur[1(*)]

[1]Center for Education and Research on Macromolecules (CERM), University of Liège, B6 Sart-Tilman, B-4000 Liège, Belgium. Fax :+3243663497; Tel: +3243663465;
[2]Université de Lyon, F-69003, Lyon, France; INSA Lyon, F-69621, Villeurbanne, France; Université Lyon 1, F-69622 Villeurbanne, France; Université de Saint-Etienne, F-42000, Saint-Etienne, France; CNRS, UMR5223, Ingénierie des Matériaux Polymères
[3]Laboratoire de Biologie Moléculaire et de Génie Génétique, Centre of Biomedical Integrative Genoproteomics, CHU, B34 Sart Tilman, B-4000 Liège, Belgium
[4] ArcelorMittal Liège Research, Bd de Colonster B57, 4000 Liège, Belgium
[5] Nanochemistry and Molecular Systems, University of Liège, B6 Sart-Tilman, B-4000 Liège, Belgium
[6] Unité de Chimie des Matériaux Inorganiques et Organiques, Université catholique de Louvain, Place L. Pasteur 1, B-1348 Louvain-la-Neuve, Belgium

Because of corrosion, chemical resistance, relevant mechanical and esthetical properties, stainless steel is widely used in the daily life, not only in the building industry but also in the food industry, the appliances or in the medical field, including implants in orthopedic surgery. However, stainless steel is unable to prevent bacteria from adhering, proliferating and forming a resistant biofilm. Therefore, surface modification is needed for providing the metal surface with antibacterial properties. The scientific literature is very rich in describing various methods for imparting antibacterial properties to different inorganic supports. However, the activity of the coating is generally time limited by the diffusion of the biocide in the environment. Novel robust and stable antibacterial coatings on stainless steel are thus highly desirable for the durability of the functionality.

In this communication, we report on an all-in-one approach to prepare robust antimicrobial films on stainless steel[1] using the layer-by-layer deposition of polyelectrolytes. Novel biocidal multilayered polyelectrolyte films in which the polycationic layer is silver loaded and bears 3,4-dihydroxyphenylalanine (DOPA), known as a promoter of adhesion to inorganic surfaces, were deposited onto stainless steel. DOPA was incorporated in the polycationic chains by radical copolymerisation of *N*-methacrylated DOPA with the commercially available quaternary ammonium salt of 2-(dimethylamino)ethyl methacrylate ($DMAEMA^+$). Polystyrene sulfonate (PSS) was the polyanionic constituent of the films. In order to boost the antibacterial activity of the polycationic layer, $AgNO_3$ was added to the aqueous solution of P(DOPA)-*co*-P($DMAEMA^+$), which resulted in the in-situ formation of silver based nanoparticles (Ag^0 and AgCl) that are sources of biocial Ag^+. The layer-by-layer deposition of aqueous P(DOPA)-*co*-P($DMAEMA^+$)/AgCl/Ag^0 suspension and aqueous solution of PSS provides stainless steel with high antibacterial activity against Gram-negative *E. Coli* bacteria. Moreover, after silver depletion, films retain some antimicrobial activity, thanks to the ammonium groups of the copolymer. We will also show how the antibacterial activity of the films can then be easily re-boosted.[1] The multi-functionality of the P(DOPA)-*co*-P($DMAEMA^+$) is a key issue in this process (i) the DOPA co-units are anchored to stainless steel, (ii) these co-units reduce partly $AgNO_3$ into Ag^0 nanoparticles and stabilize them by chelation, (iii) the chloride counter-anions react with $AgNO_3$ by ionic exchange, leading to the in situ formation of AgCl particles, and (iv) the ammonium groups are responsible for permanent antibacterial activity. Besides the advantage of the all-in-one process, another major advantage of the approach proposed here is the implementation of the whole process of film formation, including the synthesis of P(DOPA)-*co*-P($DMAEMA^+$), in aqueous media under very mild conditions. It makes the strategy very attractive for industrial scaling-up and sustainability applications.

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(*) Corresponding author: christophe.detrembleur@ulg.ac.be