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Antibacterial composite coatings of MgB_2 powders embedded in PVP matrix

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Three commercial powders of MgB_2 were tested in vitro by MTS and LDH cytotoxicity tests on the HS27 dermal cell line. Depending on powders, the toxicity concentrations were established in the range of 8.3–33.2 µg/ml. The powder with the lowest toxicity limit was embedded into polyvinylpyrrolidone (PVP), a biocompatible and biodegradable polymer, for two different concentrations. The self-replenishing MgB_2-PVP composite materials were coated on substrate materials (plastic foil of the reservoir and silicon tubes) composing a commercial urinary catheter. The influence of the PVP-reference and MgB_2-PVP novel coatings on the bacterial growth of *Staphylococcus aureus* ATCC 25923, *Enterococcus faecium* DMS 13590, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, in planktonic and biofilm state was assessed in vitro at 6, 24, and 48 h of incubation time. The MgB_2-PVP coatings are efficient both against planktonic microbes and microbial biofilms. Results open promising applications for the use of MgB_2 in the design of anti-infective strategies for different biomedical devices and systems.

The opportunistic and nosocomial agents, such as ESCAPE (*Enterococcus faecium, Staphylococcus aureus, Clostridium difficile, Acinetobacter baumannii, Pseudomonas aeruginosa,* and Enterobacteriaceae) pathogens and *Candida albicans* represent one of the most important global threats for the public health. They have the ability to adhere and develop biofilms on live tissues and implanted medical devices, consequently producing biofilm associated infections[1]. Biofilms exhibit a particular form of resistance, the phenotypic resistance or tolerance. They also have recalcitrance, i.e. the ability to survive in the presence of high concentrations of antibiotics[2].

The multiple negative consequences of biofilms development in the clinical sector underlines the need to recognize the problems contributing to poor outcomes and high costs. It also highlights the necessity of a multidisciplinary effort to prevent, combat, or eradicate biofilms. The antimicrobial strategies can be divided in microbiostatic/microbicidal based agents or on antipathogenic agents. The first ones involve the use of agents which inhibit or kill microorganisms, while the antipathogenic ones target the expression of virulence factors (e.g., adherence capacity, toxigenicity) and of their regulators (Quorum Sensing inhibitors)[3]. The antibiofilm strategies belong to both categories of the antimicrobial ones.

Nanotechnology and nanomaterials are of much interest for the development of new antimicrobial approaches, based on either novel biomaterials or on improving the biological properties of the existing ones. Currently, in a sustainable and eco-friendly driven approach, many studies are directed to design both clinically and environmentally safe nanomaterials (NMs) for antimicrobial applications. The NMs act as antimicrobial and antibiofilm agents. They can have additive or synergetic effects in combinations with antibiotics or other antimicrobials[4–7]. NMs are also useful as drug delivery for targeted release to the site of infection and as components of composites including stimuli-responsive coatings, or modified hybrid materials[8–10]. Many physico-chemical properties, such as the type of the nanomaterial, size, morphology, specific surface-area-to-volume ratio, surface charge, concentration, behavior in biological medium and pH, stability and others are conditioning their antibiofilm effect. All these factors influence the contact with the biofilm matrix and biofilm embedded cells, affecting the release of reactive oxygen species, of antimicrobial ions or of the loaded bioactive compounds[11]. NMs can be

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