Editorial

Prevention of Microbial Biofilms - The Contribution of Micro and Nanostructured Materials

Microbial biofilms are associated with drastically enhanced resistance to most of the antimicrobial agents and with frequent treatment failures, generating the search for novel strategies which can eradicate infections by preventing the persistent colonization of the hospital environment, medical devices or human tissues.

Some of the current approaches for fighting biofilms are represented by the development of novel biomaterials with increased resistance to microbial colonization and by the improvement of the current therapeutic solutions with the aid of nano(bio)technology.

This special issues includes papers describing the applications of nanotechnology and biomaterials science for the development of improved drug delivery systems and nanostructured surfaces for the prevention and treatment of medical biofilms.

Nanomaterials display unique and well-defined physical and chemical properties making them useful for biomedical applications, such as: very high surface area to volume ratio, biocompatibility, biodegradation, safety for human ingestion, capacity to support surface modification and therefore, to be combined with other bioactive molecules or substrata and more importantly being seemingly not attracting antimicrobial resistance.

The use of biomaterials is significantly contributing to the reduction of the excessive use of antibiotics, and consequently to the decrease of the emergence rate of resistant microorganisms, as well as of the associated toxic effects. Various biomaterials with intrinsic antimicrobial activity (inorganic nanoparticles, polymers, composites), medical devices for drug delivery, as well as factors influencing their antimicrobial properties are presented.

One of the presented papers reviews the recent literature on the use of magnetic nanoparticles (MNP)-based nanomaterials in antimicrobial applications for biomedicine, focusing on the growth inhibition and killing of bacteria and fungi, and, on viral inactivation. The anti-pathogenic activity of the most common types of metallic/metal oxide nanoparticles, as well as the photo-controlled targeted drug-delivery system and the development of traditional Chinese herbs nanoparticles are some of the highlights of another paper of this issue.

The applications of synthetic, biodegradable polymers for the improvement of antiinfective therapeutic and prophylactic agents (i.e., antimicrobial and anti-inflammatory agents and vaccines) activity, as well as for the design of biomaterials with increased biocompatibility and resistance to microbial colonization are also discussed, as well as one of the most recent paradigms of the pharmaceutical field and nanobiotechnology, represented by the design of smart multifunctional polymeric nanocarriers for controlled drug delivery. These systems are responding to physico-chemical changes and as a result, they can release the active substances in a controlled and targeted manner. The advantages and limitations of the main routes of polymerization by which these nanovehicles are obtained, as well as the practical appllications in the field of drug nanocarriers are presented. The authors describe the therapeutic applications of dendrimers, which are unimolecular, monodisperse nanocarriers with unique branched tree-like globular structure.

The applications of nanotechnology for the stabilization and improved release of anti-pathogenic natural or synthetic compounds, which do not interfere with the microbial growth, but inhibit different features of microbial pathogenicity are also highlighted.

We expect this special issue would offer a comprehensive update and give new directions for the design of micro/nano engineered materials to inhibit microbial colonization on the surfaces or to potentiate the efficiency of the current/novel/alternative antimicrobial agents by improving their bioavailability and pharmacokinetic features.

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