Technology Offer

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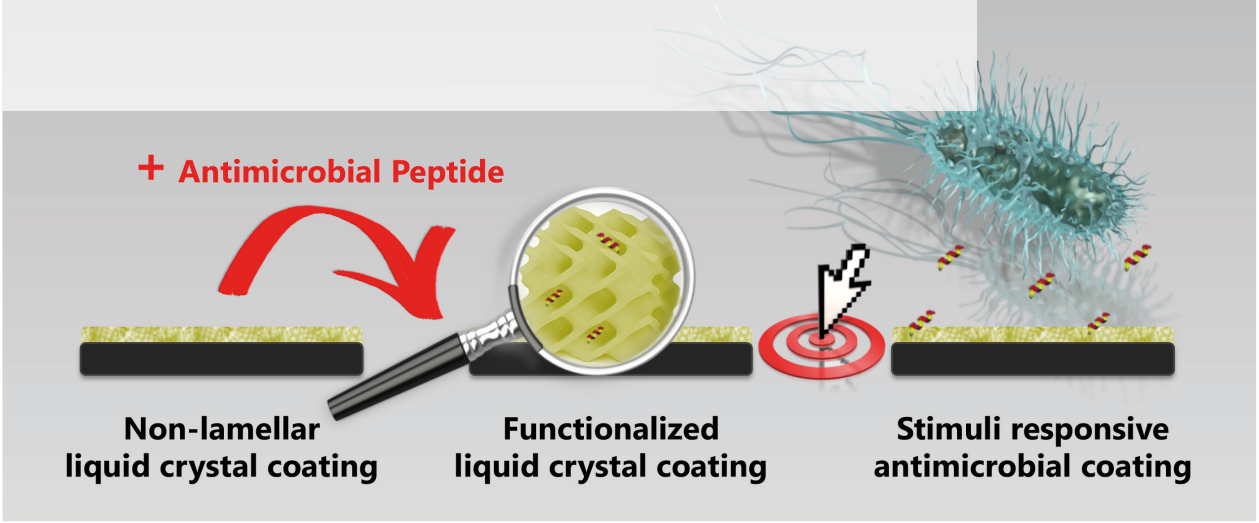
Empa
Materials Science and Technology

Stimuli-Responsive Antimicrobial Coatings



Invention

This invention demonstrates a biocompatible antimicrobial coating that is based on antimicrobial peptides (AMPs) loaded lipid liquid crystals. The coating can be applied onto various surfaces including glass, (bio) polymer films and fibers with standard coating techniques such as spin coating, drop casting, dip coating or spraying. This coating is sustainable, biodegradable and food grade. It can be functionalized with an 'on' switch for its antimicrobial activity. This switch can be targeted to triggers including temperature, pH, humidity or bacterial metabolites.

Background

The applications for smart antimicrobial coatings are manifold: on implant or catheter surfaces, they can help reducing bacterial infections after surgical treatment; on wounds, they can kill bacteria locally, before they can spread in the body; on food containers they can inhibit the growth of bacteria and increase the shelf life of food products.
The interest in efficient, sustainable and biocompatible antimicrobial coatings is growing significantly, specifically in the medical, food and pharma fields. Killing bacteria locally, at their earliest appearance can improve for instance medical therapies and food products. Avoiding the spreading of bacteria through local killing is also crucial in the context of the decreasing effectiveness of traditional antibiotics and growing concerns over bacterial resistance to treatments with conventional antibiotics.
Most of the current antimicrobial coatings have major drawbacks including toxicity, inflammatory responses, stability and unknown long-term health effects of conventional antimicrobial agents. This invention describes a biocompatible coating, based on a combination

of molecules that are also present in the human body: amphiphilic lipids and AMPs. AMPs are actually gaining increasing attention as promising alternatives to conventional antibiotics. They are part of the innate immune system and have a broad spectrum of antimicrobial activities with unspecific mode of action and low risk of resistance.

Advantages

The antimicrobial coating in this invention is based on food-grade, biocompatible components such as selected amphiphilic lipids and AMPs. Examples for the amphiphilic lipid component are: oleic acid, an important nutrient and major component of many dietary oils; and glycerol monooleate, an excipient in pharmaceutical and food industry. AMPs are, for instance, nisin that is approved as food preservative, (E number: E234) or the human cathelicidin AMP LL-37 that is currently also in clinical trial for wound healing.
In this invention, the AMPs are encapsulated within the liquid crystalline nanostructure of the coating. This nanostructure provides for protection and stabilization of the AMP. The coating in this invention can be designed to function in 'stealth' mode, with the antimicrobial activity being switched 'on' only in presence of stimuli such as pH, temperature, humidity or bacteria metabolites. The antibacterial properties of our coating have been demonstrated to be highly active against Gram-negative and *(P.Aeruginosa* and *E.coli)* and Gram-positive bacteria strains *(S.aureus)*.

Applications

The antimicrobial coatings in this invention can efficiently coat the surface of food containers, dental implants and other medical devices. A variety of applications and products are envisioned with this coating, depending on the design of the coating formulation with application-targeted combinations of lipids and antimicrobial peptides. Examples include:

- Oleic acid/nisin coating for food containers, with nisin being released from the coating upon changes of the products pH or humidity.
- Glycerol monooleate/oleic acid/LL-37 coating for wound dressings, with LL-37 being released upon change of the wounds pH.

Biocompatibility, efficiency and easy to scale-up fabrication method makes these coating a great candidate for advanced material functionalization. Potential in the food, pharmaceutical and medical industry has been envisioned for this product.

Ownership

Empa, Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH-8600 Dübendorf; Patent pending

References

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Keywords

Antimicrobial coating, liquid crystalline coating, smart coating, self-assembly, antimicrobial peptides, amphiphilic lipids, triggered release, antimicrobial nanomaterials, food, wound coating, medical devices, implants.

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