Bactericidal Surface Patterns

Tech ID: 23966 / UC Case 2013-722-0

FULL DESCRIPTION

Cellular interactions with biomedical materials are critical to the performance of medical devices. Bioflim build-up is one major cause of failure for prosthetic implants. Researchers have modified the surface chemistry of biomaterials with biocide-releasing or anti-adhesion coatings, but these are not long-term solutions. There has been increasing interest in designing nanostructured surfaces inspired by nature. Recently, researchers found that nanoscale pillar structures on the cicada wing surface had the ability to kill bacterial cells purely through physical surface topography. Here UCI researchers are developing methods that can prevent bioflim buildup through physical surface modifications similar to structures found in nature.

We created nanostructures on polymethylmethacrylate (“imprinted PMMA”). Once we made imprinted PMMA films, we plated Escherichia coli on flat and imprinted PMMA films and incubated the samples. Bacterial cells were observed using optical microscopy and scanning electron microscopy (SEM). SEM micrographs were obtained without metal coating. Using optical microscopy, we were able to see bacterial cells on the surface of both flat and imprinted PMMA films, verifying that there was bacterial adhesion on the samples. With SEM, we observed bacteria morphology and distribution on the different PMMA samples. On the flat PMMA control surface, bacteria were rodshaped, the normal morphology of E coli, and randomly distributed on the surface. On nanoLINE structures, bacteria were also rod-shaped, but most cells were oriented either along or perpendicular to the lines. Some cells along the lines became elongated. On nanoPILLARS, bacteria were randomly dispersed and appear more deflated on the pillars. We noticed that the bacteria conformed roughly to the spacing between pillars and were surrounded by cytoplasm. Many cells have also become quite elongated. The leakage of cytoplasm indicates that nanopillar structures provide bactericidal properties to the PMMA film.

We have illustrated the potential of imprinted polymer nanostructures to guide or prevent bacteria adhesion and impact the development of implantable devices by providing greater adhesion control by surface nanotexture without chemical modifications to the polymer surface. This will remove the uncertainty of proving longterm biocompatibility of a new system or chemical substance and facilitate quick implementation of the device into surgical practice. Results from this study provide a safe method for surface engineering of biomedical implants.

SUGGESTED USES

Biomedical implants and other surfaces where antibacterial properties are important.

ADVANTAGES

Non chemical based. Prevents problems related to chemical-resistant bacteria.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,875,235	12/29/2020	2013-722

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OTHER INFORMATION

CATEGORIZED AS

- » **Materials & Chemicals**
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