Fabrication of nano-structures on multiple sides of a non-planar surface

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OTHER INFORMATION

KEYWORDS

Artificial cornea, Soft lithography, Fabrication, Non-planar surface, Nano-structure, Nano-pillars, PMMA, Anti-bacterial, Bactericidal, Biomedical implant, Biomedical devices

CATEGORIZED AS

- **Engineering**
  - Engineering
- **Materials & Chemicals**
  - Nanomaterials
- **Medical**
  - Devices
- **Nanotechnology**
  - Other

BRIEF DESCRIPTION

The invention is a breakthrough in the method of fabrication of biomedical devices, making them safer and less infectious. It allows the reproduction of nano-features to one or both side of non-planar biomedical devices. This would improve the cell motility and kill bacteria.

FULL DESCRIPTION

Bacteria that adhere to the surfaces of implanted medical devices can cause catastrophic infection. Studies show that incorporating nanostructured coating will prolong the useable lifetime of a biomedical device. It prevents bacterial biofilm from building up, while serving to control and improve spatial adhesion of mammalian cells on the device surface. Unfortunately, no technology can currently apply nanostructured coating to the required range of diverse biomedical device materials and non-planar surface topologies. Furthermore, if the device will contact cells and bacteria on multiple sides, surface features (micro- or nanostructures) should cover all exposed area. Current methods do not allow such features.

Inventors at UCI succeeded in inventing a method for making curved surfaces on medical devices with nano-patterns. This method would allow the control of mammalian cell adhesion as well as providing such device surfaces with anti-bacterial and bactericidal properties. The proposed method allows the reproduction of arbitrary micro- and nano- features from a planar master mold to one or both sides of a non-planar biomedical device surface with high fidelity. With both side of the device having the nano structure, bacteria cannot proliferate and cells show increased motility on the device. Consequently, the lifetime of biomedical implants can be extended significantly as well.

SUGGESTED USES

· Fabrication of biomedical devices

· Artificial corneas, catheters and stents

· Biomedical Implants

ADVANTAGES

· Uniquely able to apply precisely nano- or microstructures biomedical device material on complex curved topographies

· Allows having Nano-structures on both side of non-planar services

· Applicable to different biomedical material surfaces

· Bacteria cannot proliferate, reducing infections

· Increases the cell motility of the device, improving host integration Extends the lifetime of biomedical implants

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,484,028	11/01/2022	2016-118

LIMITATIONS

· New fabrication method, may require modifications in the fabrication facilities

· Needs special elastomer molds

STATE OF DEVELOPMENT

· Produced a prototype for a lens-shaped device with a diameter of 1.16 cm and radius of curvature of 11.31, for use as an artificial cornea device.

RELATED CASES

2016-118-0

· Dimensions of this device will be adjusted to suit animals and human corneas for further study.

· Future steps: Create PMMA artificial cornea prototypes for in vivo studies and later on for a commercially available artificial cornea replacement.

RELATED MATERIALS

» • Liang EI: “Biomimetic Nanotopography to Control Cell Adhesion on an Artificial Cornea”, 2016 Annual Meeting | Biomedical Engineering Society | Oct. 5-8 | Minneapolis Research concerning the invention, on the inventor’s lab webpage: https://afyeegroup.wordpress.com/artificial-cornea/ - 10/05/2016

» • Dickson, Mary Nora, et al. "Nanopatterned polymer surfaces with bactericidal properties." Biointerphases 10.2 (2015): 021010. This work shows that imprinted polymer nanostructures with precisely defined geometries can kill bacteria without any chemical modifications. http://scitation.aip.org/content/avs/journal/bip/10/2/10.1116/1.4922157 - 06/01/2015

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