Seminar

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Institute for Plasma Research

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Title: Surface Modification of Silicone Catheters to Mitigate Bacterial Adhesion and Biofilm Formation

Speaker: Mrs. Purvi Dave
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Date: 9th August 2024 (Friday)

Time: 11.00 AM

Venue: Committee Room 4, IPR

Abstract

Silicone catheters, extensively used in medical procedures due to their biocompatibility, flexibility and chemical stability are prone to bacterial adhesion and subsequent biofilm formation, leading to catheter-associated urinary tract infections (CA-UTIs) which pose significant health risks and economic burden. The study was carried out specifically targeting uropathogenic Escherichia coli (E. coli), a common pathogen in urinary tract infections and aimed to develop non-toxic, antibiotic-free biofilm-resistant catheters by altering the physico-chemical surface properties of silicone catheters through plasma treatment. Later other bacterial strains were tested on catheter surfaces with optimized surface properties. This thesis presents the studies on the efficacy of plasma surface modification in mitigating bacterial adhesion and biofilm formation on silicone catheter surfaces as a single step solution.

In this study silicone catheter samples were subjected to plasma surface modification under varying process parameters. Surface characterization techniques, such as contact angle measurements, FT-IR spectroscopy, and atomic force microscopy (AFM), were employed to evaluate changes in surface hydrophilicity/ surface energy, surface functionalities, and surface topography. Plasma modified catheters were tested for bacterial adhesion and biofilm formation using uropathogenic E. coli The plasma-treated catheters showed a significant reduction in bacterial adhesion and biofilm formation compared to untreated controls. Results also revealed that both chemical and physical changes on the catheter surface contribute for reducing the bacterial adhesion, but physical changes dominate over chemical changes when both co-exist, which is a unique observation. Precise analysis of AFM results conveyed that along with the surface roughness, space and shape morphological parameters also contribute towards reduction in bacterial adhesion. Stability of plasma treated catheter surface against bacterial adhesion was found effective till 30 days under ambient storage conditions.

This comprehensive study concluded that plasma surface modification is a promising strategy for developing biofilm-resistant silicone catheters. By enhancing surface energy and evolved amplitude, space and shape morphological parameters at the optimal level, plasma treatment effectively reduces bacterial adhesion and biofilm formation, without the need of toxic chemicals, metallic coatings or antibiotics.