Faculty and PostDoc, Energy, Environment & Resource Sustainability

PREPARATION OF SLIPPERY LIQUID INFUSED POROUS SURFACES ON POLYMERIC SUBSTRATES

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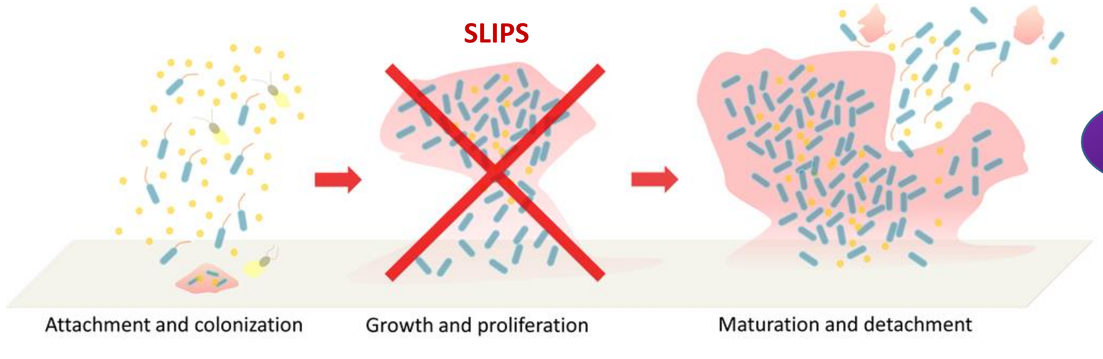
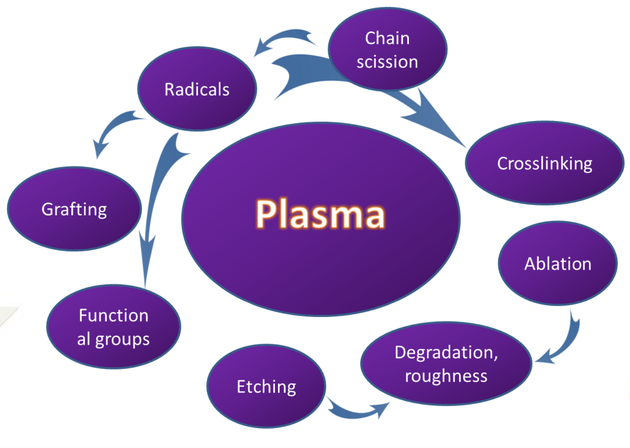
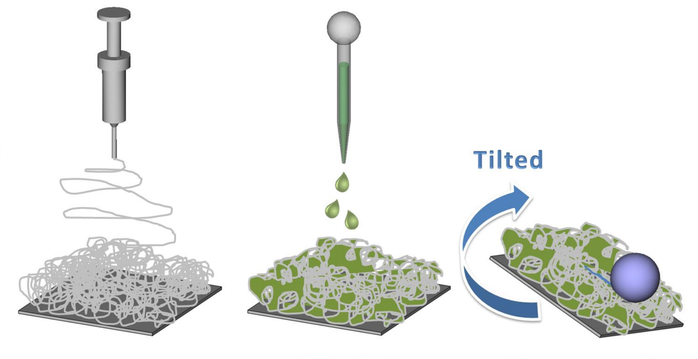
INTRODUCTION

Many **polymers** have been found in **bio-science** paralleling with advancement in a technology sector [1,2]. A selection of suitable polymers for using in a biomedical sector is based on many factors such as chemical nature, surface free energy or morphology, which influence cell-polymer surface interactions [3]. However, these materials suffering from **infections** represent **serious issues** for their applications [4]. These infections closely relate with **biofilm formation**, whereby microorganisms are strongly attached to surface forming strong attached multicellular communities [5]. Therefore, a preparation **of slippery liquid infused porous surfaces (SLIPS)** using **low-temperature plasma** technique in combination with **electrospinning technique** was utilized in this research. A multistep physicochemical approach was carried out for this purpose. The first step includes the pre-treatment of **polyethylene (PE)** and **polyurethane (PU)** substrates using low-temperature plasma to activate the surface for an adhesion improvement. Subsequently, the **3D porous network consisted of superhydrophobic fiber mats** was fabricated on the plasma activated substrates using electrospinning technique. Final step consisted of the **infusion of naturally oils** with emphasis on their antimicrobial effect. This complex strategy led to the **effective antimicrobial modification** of the PE and PU surface potentially **applicable in the biomedical field**.

ANTIMICROBIAL MODIFICATION

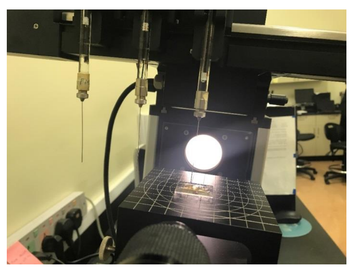


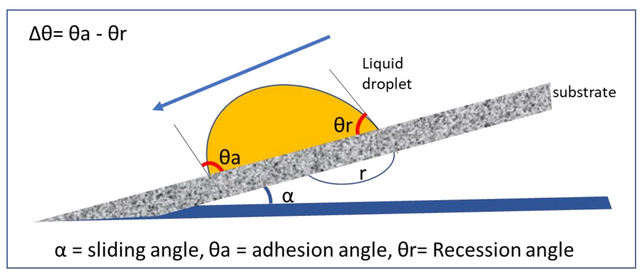


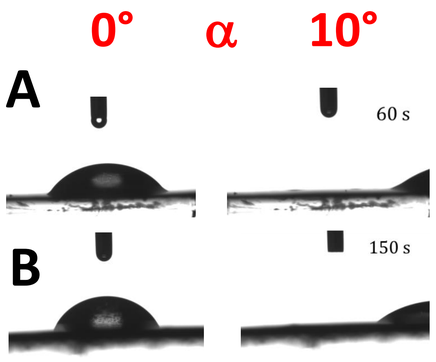


RESULTS

Slippery behavior



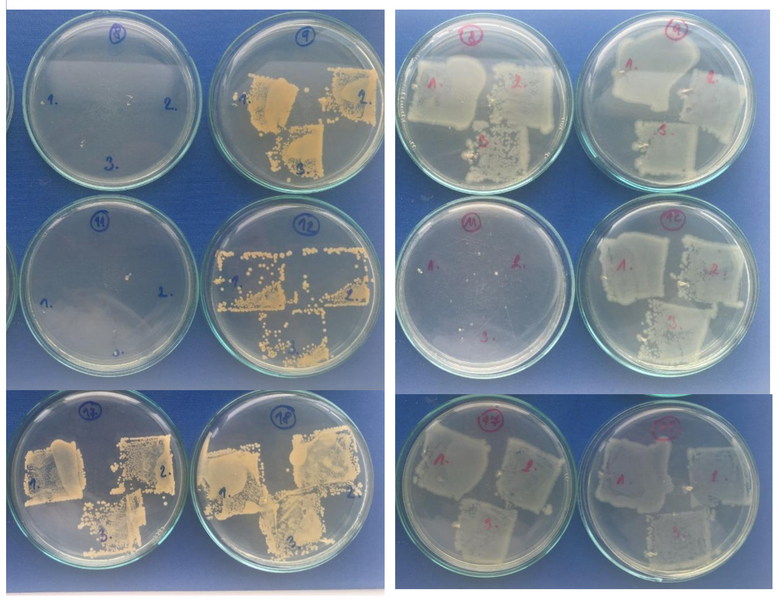




Slippery behavior of black seed oil infused in: A) PA/PDMS on PE substrate, B) PA/PDMS on PU substrate

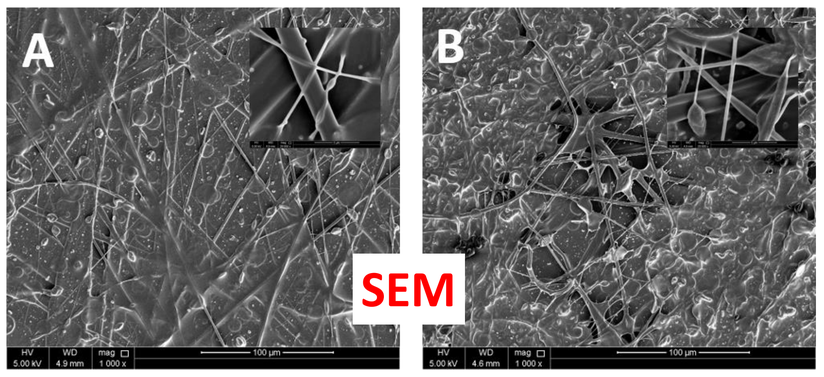
Antimicrobial activity

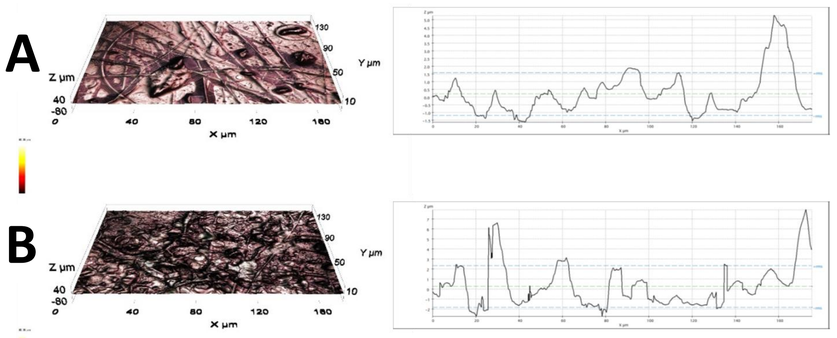
Sample	Bacterial colonies increase*	
	S. aureus CCM 4516	E. coli CCM 4517
#8 – PA/PDMS-PU-Black seed oil	0, 0, 0	4, 0-1, 4
#9 – PA/PDMS-PU-no oil	4-5, 4-5, 4-5	5, 5, 5
#11 – PA/PDMS-PE-Black seed oil	0, 0, 0	0-1, 0, 0
#12 – PA/PDMS-PE-no oil	2, 2-3, 3	4-5, 4-5, 4-5
#17 – PU	4, 4-5, 4-5	4-5, 4-5, 4-5
#18 – PE	4-5, 5, 4-5	4-5, 4-5, 5



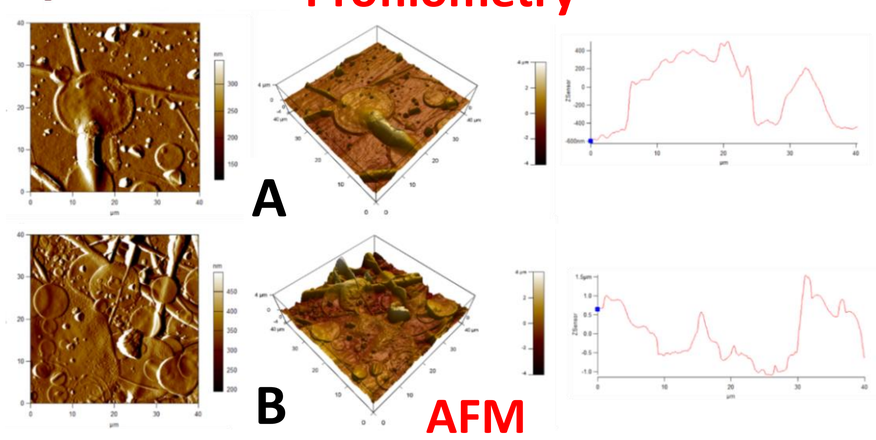
The scale for assessing the growth of bacterial colonies:
0–without growth, 1–deductible amount (single colony), 2–deductible amount (combined colony), 3–second imprint: distinguishable colonies, third imprint can be deducted, 4–third imprint: distinguishable colonies, 5–overgrown: continuous growth

Surface morphology





Profilometry



Microscopic images of black seed oil infused in PA/PDMS on: A) PE substrate, B) PU substrate

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CONCLUSIONS

- **Electrospinning technology** was successfully used for fabrication of **PA/PDMS nanoporous** structures on **PE and PU substrates**.
- **Black seed oil infusion** was responsible for **slippery behavior**.
- **Antimicrobial activity** was **proved** after **black seed oil infusion into PA/PMDS** against gram-positive **S. aureus** and gram negative **E. coli** bacteria strains.

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