Towards the development of low-cost smart textiles for the real-time monitoring of bacterial and fungi colonies

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Abstract:

The detection of pathogenic colonies is crucial in the clinical practise, for the prevention of infectious diseases. Bacterial and fungi colonies regulate their proliferation and communicate by exchanging specific compounds namely “quorum sensing molecules”. These molecules are specific within different species. As such, an early detection of these quorum sensing molecules could be beneficial for the diagnosis and prevention of infectious diseases.

This work reports a new low-cost fabrication method for the development of nanocomposite sensing fibres, which can be employed for the design of smart textiles and wearable devices. This method is based on the non-vacuum Aerosol Assisted Chemical Vapour deposition (AACVD) process [1]. The fibres incorporated biocompatible polymers with molecularly imprinted silica nanoparticles, specific for the quantification of quorum sensing molecules such as tryptophol, which is released during the proliferation of specific fungi species. The use of molecularly imprinted nanoparticles reduced the costs while maintaining a high stability and specificity of the sensors. The final devices could detect the presence of these quorum sensing molecules within a sub-µM resolution in real time, while raising a negligible response in the presence of other common interference molecules such as indoxyl sulfate. The biocompatibility and selectivity achieved by this work is essential for their use as functional biomaterials [2] and could be potentially incorporated inside smart wound dressings [3] for the monitoring of infections.

REFERENCES

[1] Choy, K.L., Chemical vapour deposition of coatings. Progress in Materials Science, 2003. 48(2): p. 57-170.
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[3] Yang, M., J. Ward, and K.-L. Choy, Nature-Inspired Bacterial Cellulose/Methylglyoxal (BC/MGO) Nanocomposite for Broad-Spectrum Antimicrobial Wound Dressing. 2020. 20(8): p. 2000070.

FIGURES

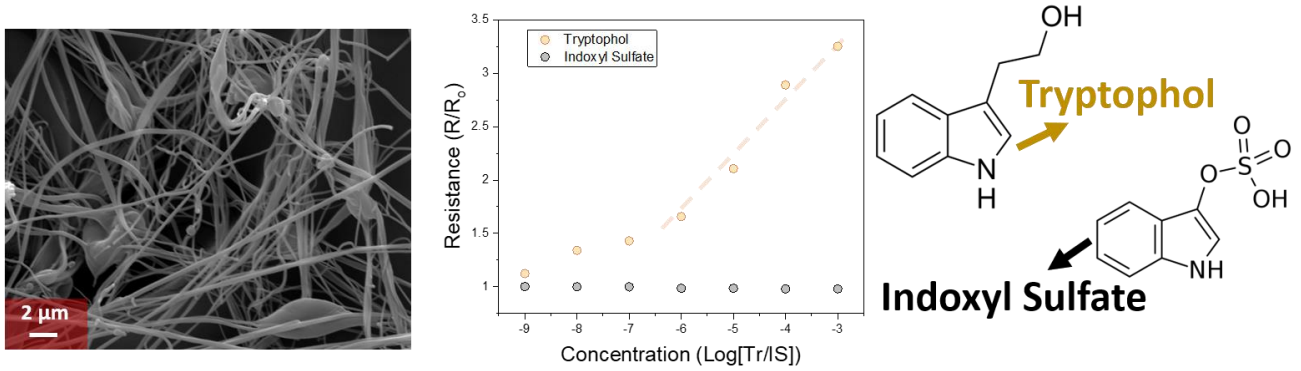

Figure 1: Left, structure of the sensing fibres at the microscale determined by scanning electron microscopy. Right, Sensitivity of the sensing devices in the presence of quorum sensing molecules (Tryptophol) and common interference molecules (Indoxyl sulfate).