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Optics and Photonics Group
Lunchtime Seminar

“Cellular electron transfer: a new direction in bioelectronics”

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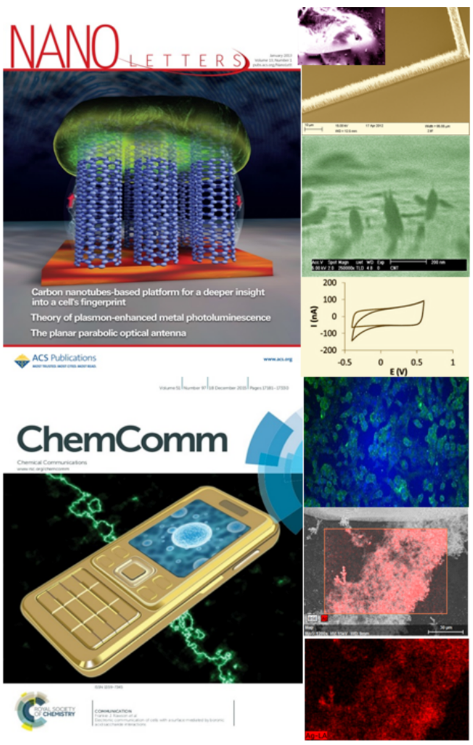

12:00pm Thursday 2nd March 2017
C17 Pope Building
All Welcome

Abstract

http://optics.nottingham.ac.uk/wiki/Talks_2017

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There is a pressing need to develop new strategies and technologies for bioelectronic applications. Bioelectronics is defined as the merging of electronic components with biology. In order to advance bioelectronic systems some key challenges are yet to be solved. One of these is that techniques are required that allow for the merging of multi-material and multi-component systems which can sense and ultimately actuate cellular behaviour. Moreover, in order to allow us to design systems to communicate with cells in their “electrical native language” a more thorough understanding of the underlying biology is required. In this seminar we will present findings that provide new insight into cellular electrical talk. In addition, the discovery of new tools to develop novel bioelectronic interfaces and sense cellular signalling will be highlighted.

We show that that eukaryotic cells expel electrons directly to their external environment. These external electron transfer mechanism appear to play an important role in cells that display high metabolic rates such as that seen for cancer and immune cells. This was made possible by development of new electrochemical based techniques, and novel nanostructured electrochemical sensors which were capable of forming an intimate biointerface. In addition, vertically aligned carbon nanostructures were used as electrochemical intracellular sensors. This technology was used to delineate the response of an innate immune response in macrophage cells by detecting H_2O_2. Importantly, these experimental observations raise some interesting biological questions and thoughts as to how such technology could be used to electrochemically control the underlying cellular biochemistry. By combining wireless electrochemistry with three-dimensional (3D) printing proof of concept is provided that novel bio/electronic functional systems could be fabricated. This coupling of wireless electrochemistry with 3D printing was then used to grow wires in situ with Chinese Hamster Ovary cells forming a bio-interfacing mesh of conductive conduits. The combining of wireless electrochemistry with 3D printing techniques provides an alluring platform to fabricate novel cellular-bioelectronic systems.

In conclusion, the work presented demonstrates that electrochemical functional nanosystems can be applied to develop bioelectronic diagnostics and treatments of the future.