



# Topical Research Meeting on Physics in Food Manufacturing

Session: Sensing, Imaging and Monitoring

## **Guided mode resonance imaging – monitoring early stage biofilm formation**

Y Wang, C Reardon, G Triggs, N Read, M Van der Woude and T Krauss

University of York, UK

Detecting the early stage of bacterial biofilm formation, i.e. the aggregation of bacterial cells and their extracellular polymeric matrix, is critical for many food-related industries. To achieve efficient and cost-effective protection of industrial manufacturing systems, it is desirable to monitor biofilm formation in real time in order to initiate appropriate early warning against biofilm maturation and to help avoid detrimental effects associated with their presence such as contamination.

Conventional biofilm detection methods typically require destructive autopsies of both the biofilm and the substrate. Alternatively, many non-invasive optical techniques, such as Raman microscopy and fluorescence spectroscopy, have been developed; however, their sensitivity and simplicity seem to be mutually exclusive. Here, we present an entirely different approach, which can be realised as a compact system with a potential cost of £10. Our approach employs guided mode resonance imaging (GMRI) to remotely monitor the earliest stage of biofilm formation on a silicon nitride substrate. GMRI works by tracking the resonant wavelength of the nanostructured substrate, which is very sensitive to refractive index changes to the extent that we can see the very early attachment of protein layers. In a further experiment, we have recently observed the formation of *Escherichia coli* biofilms in clinical concentrations in a matter of a few hours.

The rapid response and quantitative information available with our approach will lead to a better understanding of the biofilm formation processes, and will contribute to the development of more effective biofilm control strategies in food and in health product manufacturing industries.