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Identification and characterisation of *Staphylococcus aureus* on low cost screen printed carbon electrodes using impedance spectroscopyWard A C^{A1}, Hannah A J^{A1}, Kendrick S L^A, Tucker N P^B, MacGregor G^C, Connolly P^{A*}^ADepartment of Biomedical Engineering, University of Strathclyde, Glasgow, G1 1RD^BStrathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow, G4 0RE^CDepartment of Respiratory Medicine, Queen Elizabeth University Hospital, 1345 Govan Road, Glasgow¹ Authors contributed equally to the paper.

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Key wordsScreen printing; impedance spectroscopy; low cost diagnostics; *Staphylococcus aureus*; rapid testing; bacteria**Abstract**

Staphylococcus aureus infections are a cause of significant morbidity and mortality, in addition to representing a considerable economic burden. The aim of this study was to explore a low cost screen printed electrode as a sensor for the detection of *S. aureus* using impedance spectroscopy. *S. aureus* was incubated in chambers containing the electrodes and the results analysed using a novel normalisation approach. These results show that it is possible to detect the presence of *S. aureus* in LB media after 30 minutes incubation of a 1% growth culture, in addition to being able to see immediate cell concentration dependent changes in 0.9% NaCl. These observations imply that a number of electrochemical mechanisms cause a change in the impedance as a result of the presence of *S. aureus*, including adsorption to the electrode surface and the metabolism of the bacteria during growth. The study suggests that this detection approach would be useful in a number of clinical scenarios where *S. aureus* leads to difficult to treat infections.

Introduction

Staphylococcus aureus is a component of the skin's normal microflora for an estimated 30% of the population and can be a significant source of infection in immune compromised individuals (Tong et al., 2015). Prosthetic device infections, boils and serious infectious diseases such as meningitis, pneumonia and sepsis are among numerous conditions directly associated with this pathogen (Madigan et al., 2012). *S. aureus* is easily transferred between individuals both in the community and care settings due to its commensal presence with uncompromised hosts. Furthermore, it is of a growing concern due to its association with hospital acquired infections (HAI) and an increasing resistance to antibiotics (Tong et al., 2015). In Scottish paediatric hospitals, 6.1% of patients are affected by *S. aureus* infections (Reilly et al., 2012), and *S. aureus* is estimated to be the cause of around 16% of HAI in Europe. Furthermore, it has been found that over 40% of these *S. aureus* strains are methicillin resistant (ECDC, 2013; Sievert et al., 2013).

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