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Towards a carbon nanofiber (CNF) sensor with integrated microfluidics for biomarker detection

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Abstract

A carbon nanofiber array (CNF) sensor with electrochemical detection is proposed for the detection of both glucose and Interleukin 6 (IL-6), an important biomarker in immune response. The CNFs are vertically aligned with a range in diameter from 25 to 100 nm and a range in height from hundreds of nanometers to one micrometer. In this study, the CNF array is capped with polydimethylsiloxane (PDMS) microchannels that allow confined flow over the array. Prior to modifying the carbon nanofibers for biomarker detection, the flow characteristics of the system needed to be investigated. Initially, the flow characteristics of inactive CNF array sensors capped with PDMS microchannels approximately 300 µm in depth were studied. Flow rates as high as 10 ml/min were tested corresponding to pressures lower than 30 kPa revealing that the CNF array and shallow microchannels do not create a significant barrier to reagent flow. The experimental results obtained in this study were also compared to theoretical models to gain additional insight into the behavior of this system. After characterizing the fluid mechanics of capped CNF array sensors, the electrochemical characteristics of the system were investigated for the biomarkers of interest. The results of the fluid mechanics and electrochemistry studies will be discussed.

Biography

Julaunica Tigner completed her Master of Science in Mechanical Engineering in 2012 from Tuskegee University and is currently a Ph.D. candidate in Materials Science and Engineering at Tuskegee University.

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Jessica E. Koehne received her Ph.D. in Analytical Chemistry in 2009 from the University of California, Davis. She is currently a member of the NASA Ames Center for Nanotechnology where she leads the Nano-Biosensor Group. Dr. Koehne has published 29 papers in peer reviewed journals and given many technical talks at leading scientific meetings including 9 invited presentations. Dr. Koehne has received numerous awards for her technical achievements including the 2011 Presidential Early Career Award for Scientists and Engineers.

Tamara Floyd Smith completed her B.S. degree in chemical engineering at Tuskegee University in 1996 and her M.S. and Ph.D. degrees in chemical engineering at the Massachusetts Institute of Technology in 1998 and 2001 respectively. She is currently Professor of Chemical Engineering, 3M Scholar and Adjunct Professor of Materials Science and Engineering at Tuskegee University.