Wallace H. Coulter Foundation Lecture Series

Microfluidic Arrays for Protein-based Cancer Diagnostics and Toxicity Screening

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Lecture: Friday, December 8th, 2017
9:00AM-10:00AM
Room EC 1114
10555 West Flagler Street
Miami, FL 33174

FIU | Engineering & Computing
Department of Biomedical Engineering

Bio

James F. Rusling was awarded a B.Sc. in Chemistry from Drexel University in 1969, and Ph. D. from Clarkson University in 1979. He is Professor of Chemistry at University of Connecticut, and Professor of Surgery and member of the Neag Cancer Center at UConn Health Center, as well as adjunct Professor of Physical Chemistry at National Univ. of Ireland. Galway. Current research includes developing new cancer diagnostic devices for detection of biomarker proteins and peptides, low-cost 3D printed immunoarrays for point-of-care diagnostics, electrochemical and mass spectrometric arrays for toxicity screening, tumor suppressor gene damage, and fundamental bioelectrochemistry. He has authored over 400 research papers and several books, and is a also musician interested in Irish and American folk styles.

Abstract

Accurate, sensitive, multiplexed detection of biomarker proteins can provide personalized cancer detection and therapy monitoring. This seminar will describe microfluidic systems aimed at low cost devices for reliable, sensitive measurement of small panels of proteins that are biomarker for specific cancers. One system includes a small chamber for on-line protein capture from serum by labeled magnetic beads upstream of a nanostructured multi-sensor detection array to achieve high sensitivity for up to eight proteins. Nanostructured gold and carbon immunoarrays made by screen, ink-jet or computer printing provide amperometric or electrochemiluminescence (ECL) detection. Microfluidic reagent and sample delivery systems fabricated by precision cutting, molding or 3D printing provides well-controlled mass transport leading to sensitivities 1000-fold better that most commercial protein detection devices. For low cost point of care (POC) systems, we automated reagent and sample delivery utilizing a Arduino microcontroller and micropumps, with ECL detection by camera. Applications to detection of protein biomarker panels for several cancers will be described.
The same kind of technology can be applied to detect reactions of metabolites with DNA related to genotoxicity, i.e. chemical pathways that damage DNA. These arrays feature ECL detection and enzyme/DNA/metallopolymer films that form and identify reactive metabolites of test chemicals. These systems can determine chemical toxicity profiles for new drugs and chemical compounds. Using these principles, we 3-D printed an array to detect DNA damage from metabolites of chemicals in environmental samples. The ECL detection platform incorporates films of metabolic enzymes, DNA and an ECL-emitting ruthenium metallopolymer in microwells. Liquid samples are introduced into the array, metabolized by the human enzymes, products react with DNA if possible, and DNA damage is detected by ECL with a camera. Measurements of cigarette and e-cigarette smoke extracts and polluted water samples will be described.

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