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Development of microfluidic-based assays for the detection and analysis of biologically relevant species

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We describe the design and development of several microfluidic-based assays to study the bone turnover marker (BTM) osteocalcin (BGLAP) and the antibiotic teicoplanin from *Actinoplanes teichomyceticus*. Fluorescence and surface plasmon resonance (SPR) based assays were developed. In the first, fluorescence was measured upon binding the fluorescently labeled monoclonal-anti BGLAP-clone 2D5 antibody to BGLAP electrostatically attached to a microfluidic channel modified with 3-aminopropyltriethoxysilane (APTES). In the second, an open-sandwich enzyme-linked immunoadsorbent assay (ELISA) for BGLAP on a microfluidic chip was developed. In the third, BGLAP, bound to a self-assembled monolayer (SAM), was used to show binding to an unlabeled antibody using SPR. In the fourth, a magnetic bead-based technique was used to assess the binding of magnetic microspheres covalently attached to BGLAP with the fluorescently labeled antibody. A dissociation constant (K_d=330 nM) for the BGLAP-antibody interaction is reported. A genetically tuned neural network platform to optimize the fluorescence realized upon binding 5-carboxyfluorescein-D-Ala-D-Ala-D-Ala (5-FAM-$(D\text{-}Ala)_3$) (1) to teicoplanin electrostatically attached to a microfluidic channel originally modified with 3-aminopropyltriethoxysilane (APTES) is described. Here, three parameters are examined at a constant concentration of 1, with neural network methodology applied to optimize fluorescence. Optimal neural structure provided a best fit model, both for the training set (r^2=0.985) and testing set (r^2=0.967) data. Simulated results were experimentally validated demonstrating efficiency of the neural network approach. These results demonstrate the potential of developing versatile microfluidic-based platforms with various detection schemes for the study of multiple molecular systems.

Biography

Frank A. Gomez is Professor of Chemistry at California State University, Los Angeles (CSULA). He received his B.S. (1986) and Ph.D. (1991) in Chemistry from CSULA and UCLA, respectively. From 1991-1994 he was a Damon Runyon-Walter Winchell Cancer Research Fund Postdoctoral Fellow in the Department of Chemistry at Harvard University. His research group is engaged in developing fundamental and applied research in the area of microfluidics ("lab-on-a-chip" devices). Current work focuses on the development of bead-based assays, surface plasmon resonance-on-chips, and microfluidic direct methanol fuel cells. He has published over 100 technical articles and two books on his research.

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