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An integrated nanoscale optical glucose sensor with enhanced sensitivity and selectivity via dye-coupled plasmonic interferometry

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Diabetes mellitus is a chronic metabolic disorder affecting over 347 million people worldwide. Diabetics have to use a blood glucose meter (BGM) several times a day for good control of blood glucose levels. Over the past decade, extensive efforts have been exerted toward non-invasive glucose detection to overcome the limits of commercial BGMs. In this work, the combination of plasmonic interferometry with an enzyme-driven dye assay yields an optical sensor capable of detecting glucose in saliva with high sensitivity and selectivity. The sensor is built around a groove-slit-groove plasmonic interferometer coupled to the Amplex Red/Glucose Oxidase/Glucose (AR/GOx/Glucose) assay. In this implementation, GOx is added to rapidly convert glucose into gluconolactone and H_2O_2. H_2O_2 reacts with horseradish peroxidase to oxidize AR into resorufin, a dye molecule with strong optical absorption at ~571nm. The reaction is monitored by simply measuring changes in the light intensity transmitted through the slit of each interferometer. The resulting device offers real-time sensitivity as high as 1.7×10^5 % / M toward glucose in extremely small sensing volumes (£ 12 pL), and exhibits glucose selectivity in complex mixtures such as a sodium phosphate buffer solution and "artificial" saliva over the salivary physiological range of glucose concentration. These results demonstrate the viability of measuring glucose concentration in saliva, which is a complex mixture of proteins, salts, and urea. By varying the dye assay used, the plasmonic interferometry can detect low concentrations of a selective molecular target within a very small volume of biological fluid in real time.

Biography

Jing Feng is a graduate student in Brown University. She has been working on the applications of different optical sensing techniques, and published more than 10 papers in reputed journals.

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