GUIDED-MODE RESONANCE BIOCHIP SYSTEM FOR EARLY DETECTION OF OVARIAN CANCER

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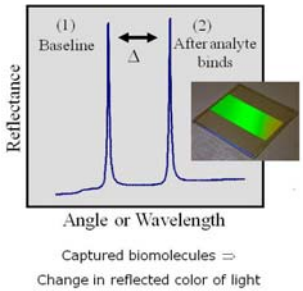
Background and Overview

A high-accuracy, sensor system has been developed that provides near-instantaneous detection of biomarker proteins as indicators of ovarian serous papillary carcinoma. Based upon photonic guided-mode resonance technology, these high-resolution sensors employ multiple resonance peaks to rapidly test for relevant proteins in complex biological samples. This label-free sensor approach requires minimal sample processing and has the capability to measure multiple agents simultaneously and in real time. In this work, a sensor system that uses a fixed-wavelength source with a shaped input wavefront to auto-scan in angle is utilized to provide a portable format. As binding events occur at the sensor surface, resonance peak/null shifts are tracked as a function of incident angle on an integrated CMOS detector. The amount of angular shift is linearly correlated to the quantity of biomarker protein in a biological sample. Multiple resonance tracking provide increased detection information about the binding dynamics occurring at the sensor surface, thus decreasing false detection readings. Simultaneous detection of multiple biomarker proteins in parallel with sensitivities in the pM range contributes to the potential for differential real-time data analysis. A biochip system prototype is under development which allows the identification and quantification of protein biomarkers that are up- or down- regulated in blood and serum as indicators of ovarian cancer.

Direct detection advantage

Features	Current label-based approaches	RSI label-free sensor system
Time to measure a biochemical reaction	4-24 hours (typical).	<30 minutes (typical).
Chemical processing to detect biochemical reaction	2-3 incubation steps and 10-15 washing steps before readout.	Real-time, direct monitoring of biochemical reaction.
Sensitivity	pM range (commercial benchtop plate readers).	pM range
Binding kinetics	not capable	Yes

Guided-mode resonance sensor technology

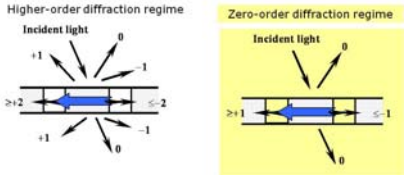


Fast - instant results, no chemical labels required
High accuracy –multiple detection peaks
High sensitivity – detection of small molecules as well as virus, bacteria and cells
Mass producible – high density formats in disposable materials
Quantitative or qualitative results

Resonance Interactions

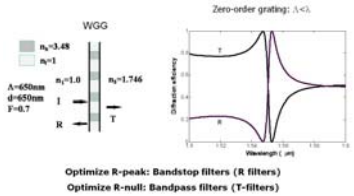
Basic resonance interactions

Excitation of a leaky eigenmode in 1D dielectric WGG

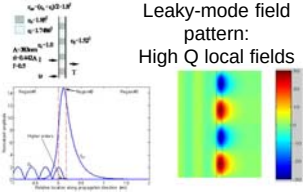


Guided-mode resonance effect

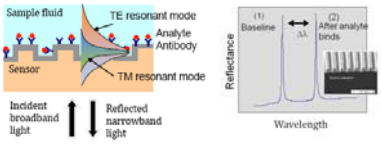
Computed example



Leaky-mode field pattern: High Q local fields

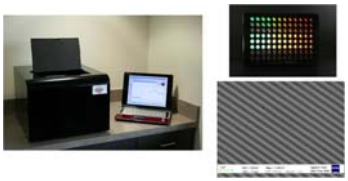


Guided-mode resonance sensor system

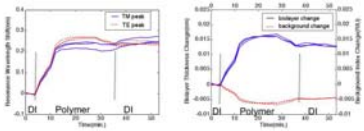


RESULTS

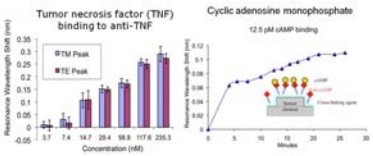
Benchtop sensor system



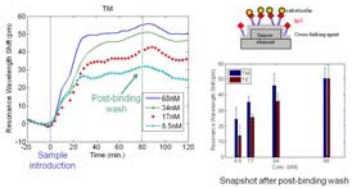
Multiple resonance detection provides increased accuracy



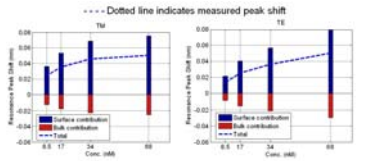
Detection of biomolecules



Calreticulin binding to IgG antibody



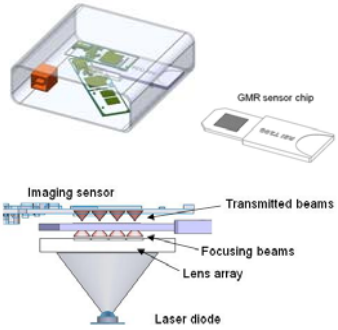
Contributions from surface/bulk to each resonance peak shift



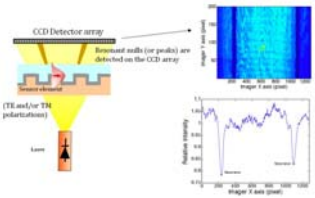
Sensitivity to targeted biochemical interaction can be enhanced by accounting for background index variations

Ryanodine Receptor 3 in tissue samples

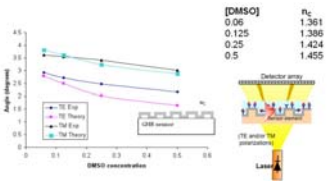
Portable biochip system



Angular detection mode



Solvent tests



Conclusions

- Rapid label-free sensor system in portable formats
- Multiple resonance detection enhances accuracy
- Real-time results, washing steps not required
- High density arrays possible for simultaneous multi- analyte tests
- Can be applied to rapid biomarker screening for cancer detection and disease prevention

ACKNOWLEDGEMENTS

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