

NEW INSTRUMENT BASED ON EVANESCENT WAVE FOR AFFINITY SENSING

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INTRODUCTION: A new instrument was developed for surface reaction monitoring. It is based on waveguide grating and wavelength modulation¹. The wavelength at which the resonant coupling occurs depends on the waveguide grating characteristics. The changes in the resonance wavelength represent variations that occur in evanescent wave of the waveguide (refractive index, layer deposition, material phase change or swelling).

METHODS: The instrument breadboard is composed of a tuneable semiconductor laser, a waveguide grating chip with two waveguide grating pads per measurement channel, one pad with a 360 nm period grating and about 150 nm thick waveguide (incoupling) and one pad with same grating period but with a 300 nm thick waveguide (outcoupling), the waveguide layer is made of a Ta₂O₅ on glass substrate (Schott AF45). The chip is mounted in a cell for pipetting liquid (a cell with two different chambers is also available). A fibre ribbon is used to collect the outcoupled light and to propagate it to the detectors. The electronic system controls the laser temperature, modulates the laser current (in order to modulate the laser wavelength), amplifies the detector signal. The PC makes data acquisition calculates the resonance position, and display it. The system was tested in three cases: refractive index change, molecular recognition using photo-bonded material and antibody, molecular recognition with physisorbed neutravidin and biotinylated molecules.

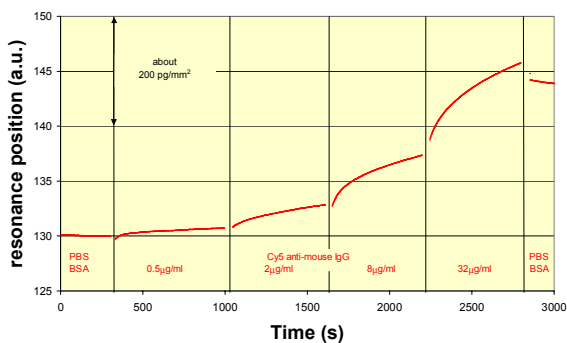


Fig. 1: Recognition of photo-bonded mouse IgG with an antimouse antibody.

RESULTS: Refractive index changes are made using mixtures of water and glycerol (0 to 2%). Solutions with different concentration of glycerol applied on the chip. Standard deviation on effective refractive index measurement as low as $3 \cdot 10^{-8}$ are obtained. For molecular recognition with antibody, mouse IgG was photo-bonded with OptoDex[®] on the waveguide surface and an anti-mouse antibody solution at different concentration were applied to see the immunoreaction (see Fig. 1).

The third experiment was made using the double chamber cell, in one chamber BSA was physisorbed and in the other neutravidin, then Biotin-5N-FITC at 10 µg/ml was put in both chambers and the binding of biotin on neutravidin only is observed (Fig. 2).

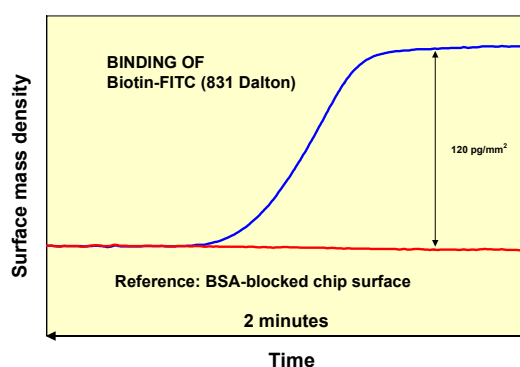


Fig. 2: Binding of biotin-FITC on physisorbed neutravidin

DISCUSSION & CONCLUSIONS: The measurements show that very high sensitivity ($3 \cdot 10^{-8}$ refractive index variation) can be reached. This proves the potential of the new concept combining wavelength modulation and glass waveguide grating. The system is well adapted for the study of affinity binding of large (antibody) and small (less than 1000 Dalton) molecules.

REFERENCES: ¹ M. Wiki and R.E. Kunz, "Wavelength-interrogated optical sensors for biochemical applications," Opt. Lett. Vol. 25/7, 463-465 (April 1, 2000)

ACKNOWLEDGEMENTS: Part of this work was funded by CTI (Commission for Technology and Innovation)