Optical Waveguide Lightmode Spectroscopy System

OWLS Sensors

Real-time Label-free Biomolecular Interaction Analysis

- Determination of two independent parameters of the adsorbed layer
- Self-calibration of the individual sensor chip parameters
- Flexible choice of surface coating material
- Simultaneous measurement of optical and electrochemical parameters
- Low operating cost, regular chemicals, consumables

- Adsorption of proteins at surfaces
- Ligand/receptor binding, Immunosensing
- Protein - lipid bilayer interactions
- Protein - DNA interactions
- Growth and spread of living cells at surfaces
- Cell assays
- Food quality monitoring
- Bio compatibility study

MicroVacuum
www.owls-sensors.com

OWLS 210 Modular Biosensor System

BASIC INSTRUMENT FOR OPTICAL WAVEGUIDE LIGHTMODE SPECTROSCOPY

- Real-time monitoring of surface binding process via measurement of optical properties: refractive index, thickness, mass of the nanolayer on the surface of optical biosensor chip.
- High-sensitivity, high-stability of the measurements are achieved by proprietary design of the opto-mechanical components and by the precise temperature control (10°C - 80°C ± 0.1°C) of the sensor and the flow-cell.
- BioSense software provides flexible control of OWLS 210 instrument and its modular subsystems. It is designed for easy & flexible parameter set-up & data display.
- Typical sensitivity:
  effective refractive index: N_{TE} N_{TM} ~2-4 x 10
  thickness of adlayer: subnanometer
  surface mass ~1ng/cm

MICROFLUIDICS SOLUTIONS

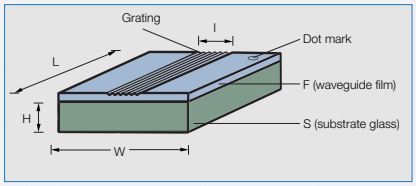
Microfluidics are designed to use low cost standard HPLC fittings and tubing which can be easily field changed or replaced.

- TEFLON®, PEEK® biocompatible tubing
- Flow-cell made from PEEK® with Kalrez® O-ring

Several sample injection methods are offered:

- Manual syringe sample injection directly to the flow-cell OWLS_SIS sample injection subunit provides bubble-free, controlled flow rate fluid supply through the flow-cell, controlled-volume sample injection via manual injector valve with selectable volume sample loop made from biocompatible PEEK® material
- Autosampler unit automatically injects the sample from 384/96 well plates or vial trays. Sample cooling to 4 °C is available. Experimental protocols controlled by the Bio-Sense software.

OW 2400 OPTICAL GRATING-COUPLER SENSOR CHIP



Grating: periodicity = 2400 lines/mm (0,4166 µm); length(l) ~2 mm
Substrate glass: length (L)=12 mm, width (w)= 8 mm,
thickness (H)=0,50 mm, refractive index (n_S)=1,53
Waveguide: material (SOL-GEL) $Si_xTi_{(1-x)}O_2$, where x~0,25±0,05
refractive index (n_F)=1,77±0,03; thickness (d_F)=170-220 nm

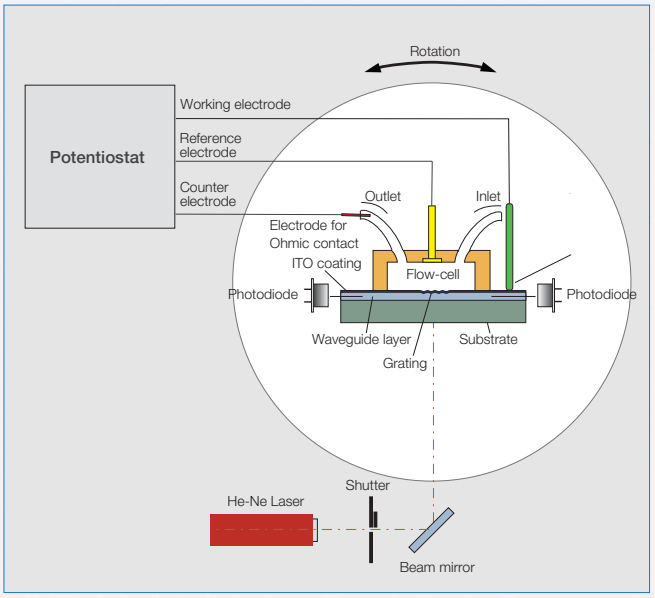
OW 2400C COATED SENSOR CHIP

Implements a coating layer on the waveguide surface, that modifies the optical, chemical or biochemical properties of the chip to the required extent.
Several metal oxide (SiO_2, TiO_2, Ta_2O_5, Al_2O_3 ITO etc.) polymer (AF Teflon, polyethylene etc.), and functionalized (APTES silanized, biotinated etc.) sensor surfaces are available.

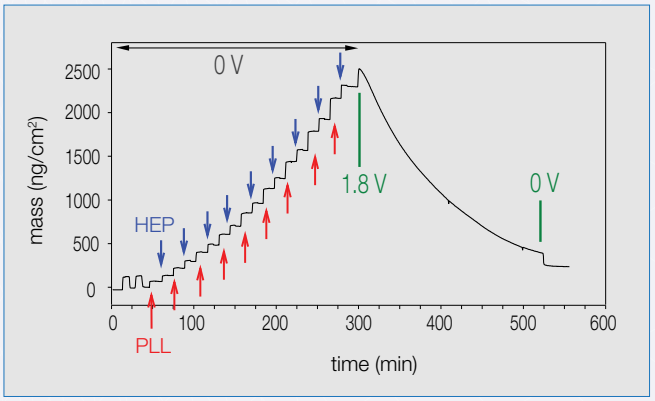
ELECTROCHEMICAL - OWLS SYSTEM

- Three wires EC flow-cell for parallel optical & electrochemical measurements
- Potentiostat module is built into the basic OWLS instrument.
- ITO-coated OW 2400 sensors: Transparent electrically conductive ITO layer on the sensor surface allows optical investigation of surface adsorption process under electric field.
- BioSensor software allows running standard techniques such as chronoamperometry, chronopotentiometry, cyclic voltammetry parallel with OWLS measurements, when potentiostat is connected to EC-OWLS flow-cell.

ELECTROCHEMICAL - OWLS SETUP



EC-OWLS MEASUREMENT: EFFECT OF THE ELECTRICAL FIELD ON THE LAYER FORMATION

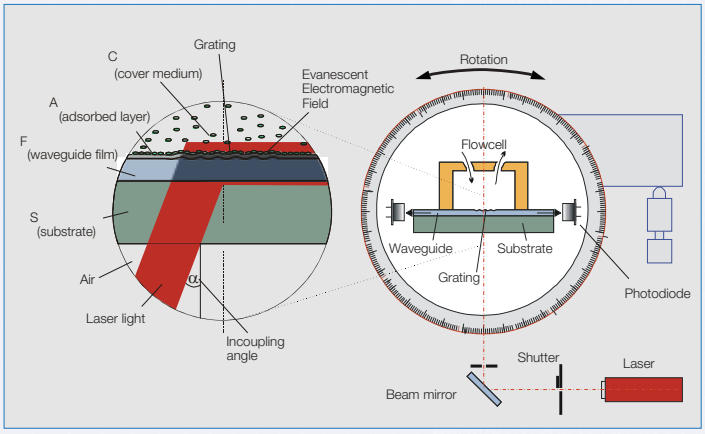


Build up of absorbed mass measured with EC-OWLS during the alternate deposition of PLL and HEP layers at an electrical potential of 0V. Application of 1.8V dissolves the polyelectrolite layer as it is observed by the decrease of mass.

Measurements were made in ETH Zurich, Laboratory for Surface Science and Technology, www.surface.mat.ethz.ch

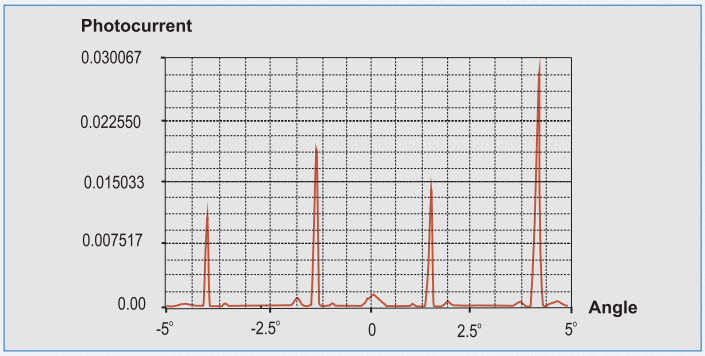
Explore Interactions with OWLS technology

SENSING PRINCIPLE

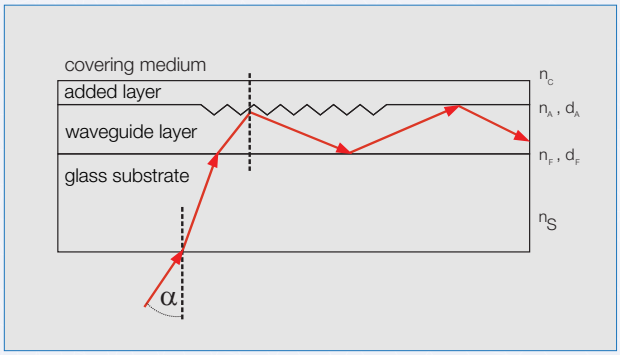


The basic principle of the OWLS method is that linearly polarized light (He-Ne laser) is coupled by a diffraction grating into the waveguide layer, provided that the incoupling condition is fulfilled.
The incoupling is a resonance phenomenon, that occurs at a precise angle of incidence which depends on the refractive index of the medium covering the surface of the waveguide. In the waveguide layer the light is guided by total internal reflection to the ends where it is detected by photodiodes. By varying the angle of incidence of the light an incoupling spectrum can be obtained from which the effective refractive indices are calculated for both the electric and magnetic modes (N_{TE}, N_{TM}).

OWLS IN-COUPLING SPECTRUM

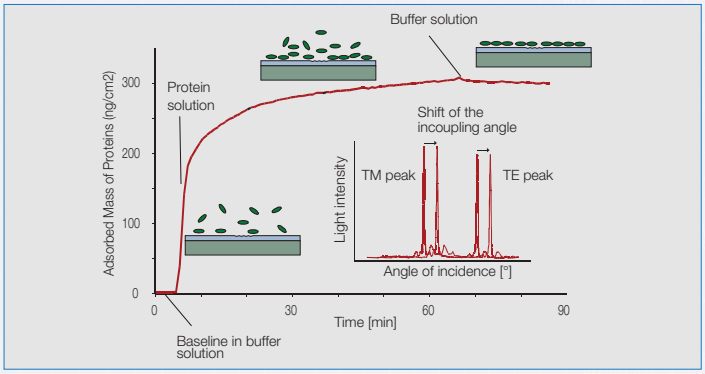


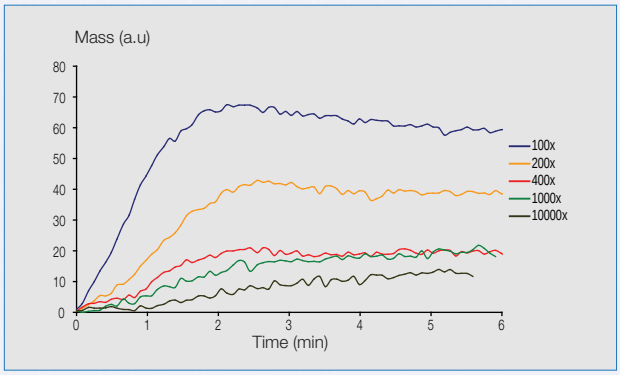
RAY-OPTIC REPRESENSATION OF A COUPLED AND GUIDED WAWE



Supposing that N_{TE}, N_{TM} have been calculated from the α_{TE}, α_{TM} incoupling angles and the optical parameters of the waveguide layer (n_F,d_F), of the substrate (n_S), of the covering medium (n_C) are known, the refractive index (n_A), the thickness (d_A) and the mass (M) per area of the added layer can be determined.

ANALYSIS OF ASSOCIATION AND DISSOCIATION KINETICS





Baseline-run in pure buffer: determination of the refractive index n_F and the thickness d_F, of the waveguide results in self-calibration of the sensor parameters in situ, thus eliminating the small differences from one chip to the others.
Adsorption experiment: monitors the evolution of adlayer parameters n_A, d_A.
In situ determination of the adsorbed mass M and the kinetics of adlayer formation.
Desorption phase: this is a washing step in pure buffer, which provides information about the stability of the formed adlayer and the possible desorption kinetics.

Competitive immunosensor responses obtained for different aflatoxin B1 monoclonal antibody dilutions. Comparing the signals, antiserum dilution of 400 and 1000 can be considered suitable for measurements. At these dilutions responses given by the sensor are high enough for evaluations, yet the method is still sufficiently sensitive to detect small amounts of mycotoxins. (Concentration of the aflatoxin conjugate applied was 10 µg/ml on silanized sensor). Measurements were made in Unit ofAnalytics, CFRI, Budapest.
www.cfri.hu

OWLS 210 Product List

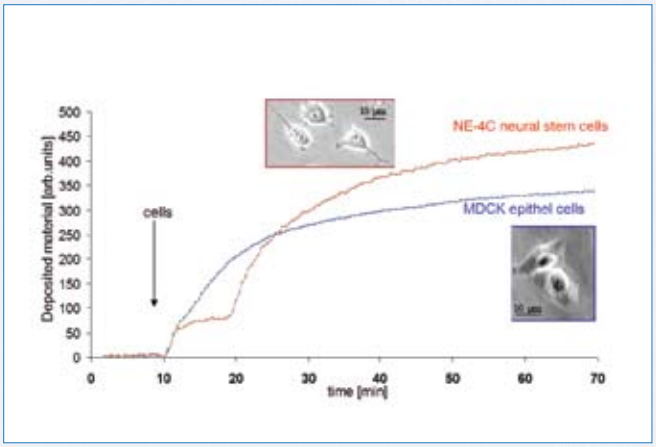
- OWLS 210 Main unit
- Apple iMAC®
- BioSense software, free BioSense software upgrade for 2 years
- Integrated sensor holder
- Sample Injection System
- On-site installation and customer training
- 2 years warranty at the manufacturer's site
- Remote technical support via Internet by TeamViewer software

Options:
- BioSense controlled potenciostat for the EC-OWLS measurement
- BioSense controlled robotic asutosampler

For detailed specification visit www.owls-sensors.com or ask for the current product list from info@microvacuum.com

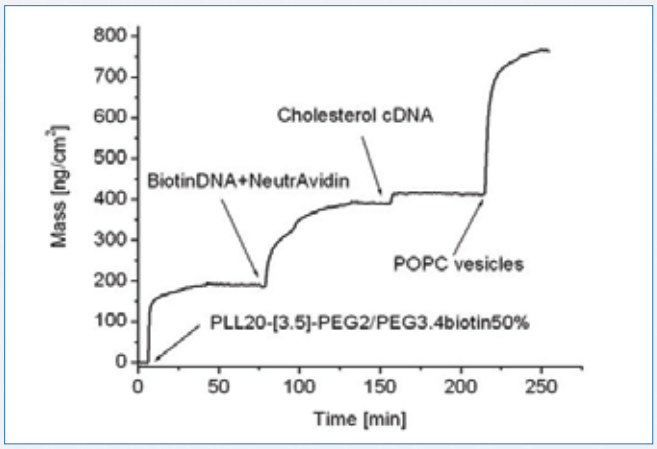
APPLICATION EXAMPLES

STUDY OF THEKINETICS OF CELL - ATTACHMENT



Adsorbed mass determined with OWLS measurement indicates the distinct kinetics of attachment of different types of cells.
Kidney epithelial (MDCK) cells and NE-4C embryonic neuroectodermal stem cells were seeded on poly-L-lysine coated OWLS sensors in serum-free (arteficial cerebrospinal fluid) medium, at 37°C. The kinetics of material deposition o the sensor surface was recorded during the initial attachment period. MDCK cells rapidly adhering by wide lamellipodia to a variety of different substrates generated a mon-phasic, saturation-like binding curve, while the attachment of neural stem, those elongating numerous minor processes before spreading, resulted in a multiphase deposition curve.
Measurements were made in the Laboratory of Cellular and Developmental Neurobiology, Institute of Experimental Medicine of Hungarian Academy of Sciences, Budapest, www.koki.hu

BINDING CURVE OF INTACT VESICLE IMMOBILIZATRION



A binding curve of a cholesterol cDNA immobilization experiment monitored with OWLS in HEPES 2.
First, PLL-g-PEGbiotin is adsorbed on a Nb_2O_5-coated-waveguide. Next, the biotinDNA-NeutrAvidin complexes are immobilized. The cholesterol cDNA is hybridized to the immobilized biotinDNA. Finally 50 nm vesicles can be absorbed via the incorporation of the cholesterol into the membrane of the vesicles.

Measurements were made in the Laboratory of Biosensors and Bioelectronics, Institute for Biomedical Engineering, ETH Zurich
www.lbb.ethz.ch

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