Experimental session

Surface plasmon resonance method for precise detection of low concentration solutions

Friday, 17 Feb 2017 **17.15-19.00** **Location: Multidisciplinary Laboratory** **Speaker: Viktor Lysiuk** ***Tutor: Zeinab Ebrahimpour;*** ***Groups: 4, 5, 6***	**Wednesday, 22 Feb 2017** **16.00-18.00** **Location: Multidisciplinary Laboratory** **Speaker: Viktor Lysiuk** ***Tutor: Jorge Alex Villabona;*** ***Groups: 1, 2, 3***

Surface plasmon resonance (SPR) refractometer "PLASMON-6" *Operation regimes: angular scanning (multiple), single angle dynamic measurement (slope). Laser wavelength 650 nm. Prism refractive index n=1.61.*
Sensors*: *glass plates coated by thin golden films: 20x20* ***mm****, glass thickness: 1 mm. glass refractive index n=1.61, Au film thickness 50 nm.*
****It is possible to use sensors of participants.*** Substrate thickness should be less or equal 1 mm. Coating: metallic or semiconductor, flat or nanostructured. Sensor dimensions are flexible, from 5X5 mm up to 30x30 mm (square or rectangular).
Other materials: Peristaltic pump, Eppendorfs, Glass Flasks, Snorkels. **Reagents:** NaCl, Ethanol, BSA, HCl acid, Distilled water. **Software:** "Plasmon-6" installed on PC or laptop.

Measurements of solution refractive index as a function of its concentration. Determination of threshold sensitivity of SPR sensor.

Selected group members may prepare solution with known concentration (for NaCl is recommended from 1 to 10 mg/ml) and keep it confidential with others until item 11.

1		Install required sensor to cuvette, connect it to eppendorf and glass flake by snorkels through peristaltic pump or injector.
2		Open “Plasmon-6” software and select slope or multiple Mode.
3		Make 1st measurement of SPR curve on air. Try slope and multiple regime and select the best one for precise measurements.
4		Prepare NaCl (recommended 9 mg/ml) or ethanol solution using distilled water.
5	REPEAT	Inject solution to cuvette, start continuous measurement and wait until SPR curve will be stabilized due to its sensitivity to pressure and temperature in cuvette.
6		Make continuous injection of distilled water to remove the rest of NaCl solution.
7		Prepare twice less concentration of solution and come back to item 5. Repeat until the curve is possible to detect among noises. Get the lowest solution concentration – it will be threshold sensitivity of SPR sensor.
8		Get the signal values with related concentrations and paste them to table.
9		Build the curve using appropriate extrapolation method.
10		Use the solution prepared by selected group members. Its concentration is unknown for the others. Do operations listed in items 5 - 6 for unknown solution concentration. Use extrapolation curve to determine this concentration.
11		Check obtained results with those who prepared this solution. Compare the deviation with accuracy and value of threshold sensitivity.

If group of participants are interested to use their own sensor – they can compare its sensitivity by making the same experiments, or use their own reagents to make appropriate measurements on their sensor installed to SPR scanner “Plasmon-6”. Sensor dimension and material requirements are described above in equipment description.

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Surface plasmon resonance refractometer

PLASMON-6

The most used applications:

- **Realization of real time biokinetic, immunosensing and biosensing techniques**
- **Studies of adsorption, corrosion, electrochemical reactions**
- **Thin organic and inorganic film characterization and refractive index measurements**
- **Gas and liquid composition detection and chemosensor applications**

Ffields of application:

- **Veterinary medicine**
- **Medicine**
- **Biotechnology**
- **Food industry**
- **Ecological monitoring**
- **Customs supervision**

Surface plasmon resonance (SPR) is a unique optical surface sensing technique that is responsive to refractive index changes that occur within the vicinity of a sensor surface. Thus, SPR can be used to monitor any physical phenomenon which alters the refractive index at the surface and has grown into a versatile technique used in variety of applications. Of special interest is its potential for biosensing techniques.

The **PLASMON-6** is a computer-controlled SPR refractometer that implements the Kretschmann prism arrangement. A 50 nm film of gold is deposited onto a glass slide which is brought into optical contact with the prism using refractive index matching fluid. This gold film forms the sensor surface where the surface plasmons are excited using a polarized light emitted by a semiconductor laser (λ=650nm). The laser light is launched into the rotating ATR prism where it can couple with the surface mode to yield the surface plasmons. Excitation of plasmons is evidenced by a resonant dip in the reflectance of the gold film under the correct coupling conditions.

The angular dependence of this intensity (the resonance curve) reflects variation of the SPR coupling level and represents the sensor output. Its shape, especially position of the resonant dip, allows for the refractive index and the thickness of the layer coated upon the gold film to be elucidated. Surface plasmons are confined to the plane of the gold film, producing evanescent electromagnetic field. It extends over ~1 μm from the surface, that makes this technique essentially surface-sensitive.

Depend on modification device has one or two optical channels. Second channel can be used as measuring or reference. Modification of the instrument destined for electrochemical applications features additional ADC input and software means for recording of voltamperograms simultaneously with the optical signal.

System Specifications:

Refractive index measurement range	1.0 – 1.43
Detection limit of refractive index variation	0.00005
Angle-of-incidence setting precision	10 angular sec
Maximum angular scan	17º
Total measurement time of a single resonant curve	3 sec
Maximum time resolution of kinetics measurements:	≤ 3 sec
Maximum time resolution for Tracing measurement mode	1 sec
Maximum time resolution for Slope measurement mode	0.2 sec
Number of optical channels	2
Light source	GaAs laser (λ=650 nm)
Additional ADC input (optional)	±5V
Overall dimensions of the measurement unit	215x130x100 mm
Weight	2.5 kg
Computer connect	COM port, USB
Control and data processing software Windows	95/98/ME/XP/7

Accessories

- Replaceable ATR prisms (1.51≤n≤1.64) for measurements in gaseous and liquid phases;
- Refractive index matched glass substrates (1.51≤n≤1.64) with plasmon-supporting layer (vacuum-deposited 45 nm thick gold thin film);
- Replaceable sample cells of different volume.

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