Highly sensitive integrated optical biosensing platform based on an asymmetric Mach-Zehnder interferometer and material-selective (bio)functionalization

Anke Schuetz-Trilling

E Anke.Trilling@surfix.nl
T +31 85 488 1285
Our conviction

> Micro- and nanotechnology are an integral part of sustainable solutions for major global challenges in healthcare, food and energy.

> At Surfix we believe that accurate and precise control of surface properties will enable our customer to exploit the full potential of their world changing devices.
What we offer for your device

- Tailor-made nanocoatings
- Superior spatial control
- Cost-effective and manufacturable solutions

Surface properties

- Hydrophilic
- Hydrophobic
- Anti-biofouling
- Biofunctionalizable
What we offer for you

› Highly motivated people dedicated to solving your surface modification challenges
› Personal relationships and open communication

› State-of-the-art surface characterization and analysis
› Demonstrator devices for nanocoating validation
› Coating of commercial devices
› Technology transfer and IP licensing
Nanocoating architectures

- 2D nanocoatings
- 3D nanocoatings

Glass / Semiconductors / Plastics / Metals / Metal oxides / (Nitro)Cellulose
Patterning options

- Uniform nanocoating
- Local nanocoating
- Material-selective nanocoating
Integrated optics measurement platform

One measurement set-up for both:
Micro-ring resonator (MRR) as well as asymmetric Mach-Zehnder Interferometer (aMZI)

Light input:
VCSEL with wavelength modulated signal around 850 nm

Light output:
Photodiodes to measure optical power output

Acquisition of data:
DAQ-Card

Signal processing:
PC with LabView algorithms for peak detection/phase detection
Sensor response: MRR versus aMZI

Micro-ring resonator (MRR):

Asymmetric Mach-Zehnder Interferometer (aMZI):
Nanocoatings: uniform vs material-selective

- Optofluidic waveguide sensor: $\text{Si}_3\text{N}_4 / \text{SiO}_2$

- Uniform nanocoating:

- Material-selective nanocoating:
Material-selective coating:
Fluorescence: study interaction with fluorescently labeled proteins

1) NHS/EDC
2) Fluorescent protein

1) No activation!
2) Fluorescent protein

Negative control:
physical adsorption on non-modified surface
Material-selective coating:
Fluorescence: study interaction with fluorescently labeled proteins

Model proteins: BSA (66.5 KDa, pl 4.7) Lysozyme (14.3 KDa, pl 11.4)

Negative control:
physical adsorption on non-modified surface
aMZI sensor chips: spotting

<table>
<thead>
<tr>
<th>Sensor #</th>
<th>capture-molecule</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Mouse IgG</td>
</tr>
<tr>
<td>2</td>
<td>Rabbit IgG</td>
</tr>
<tr>
<td>3</td>
<td>Mouse IgG</td>
</tr>
<tr>
<td>4</td>
<td>Rabbit IgG</td>
</tr>
<tr>
<td>5</td>
<td>Mouse IgG</td>
</tr>
<tr>
<td>6</td>
<td>Rabbit IgG</td>
</tr>
</tbody>
</table>

Chip design
Unbalanced aMZI

Example spotting
Comparison of selective versus not-selective

Capture molecule: mouse IgG, analyte: anti-Mouse IgG

signal referenced with a rabbit IgG capture antibody sensor to subtract unspecific binding
Comparison of selective versus not-selective

Shift as a function of analyte concentration (Anti-Mouse IgG) II

Single logarithmic

Double logarithmic

4-9 x ↑ signal
Summary

- material-selective nanocoating
- 4-9 x ↑ signal at low analyte concentrations

Acknowledgements

Fluorescently labelled Avidin on a material-selective coated aMZI