

PHOTONICS RESEARCH GROUP

TOWARDS MULTIPLEXED SERS-BASED ON-CHIP DETECTION OF PROTEASE ACTIVITY

Edyta Turk, P. Wuytens, H. Derou, K. Gevaert, A. Skabach, M. Lambart and R. Baets

SERS CAN BE USED TO MONITOR PROTEASE ACTIVITY.

- Proteases are enzymes catalyzing the hydrolysis of peptide bonds.
- Play a role in a variety of diseases and thus important as drug targets.

→ Need for a **real time, multiplexed** method to analyze protease activity

SURFACE-ENHANCED RAMAN SPECTROSCOPY (SERS) ENABLES SELECTIVE AND SENSITIVE DETECTION.

- Raman signals are specific for a molecule.
- Raman signals are enhanced close to the surface of gold nanostructures.

SERS CAN BE USED TO MONITOR PROTEASE ACTIVITY.

Before enzymatic activity

Raman intensity

Stokes shift (cm⁻¹)

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Before enzymatic activity

After enzymatic activity

Raman intensity

Stokes shift (cm⁻¹)

PEPTIDES SHOULD FORM A STABLE AND ACCESSIBLE MONOLAYER ON THE GOLD SURFACE.

Au-S bond monolayer formation

aromatic amino-acid

spacer to improve accessibility

trypsin cleavage site

aromatic amino-acid

Winters et al., Farad. Discussions, 2017

TRYPSIN ACTIVITY WAS DETECTED THROUGH SERS SPECTRA OF SURFACE-BOUND PEPTIDES.

Reference

Trypsin Inhibitor

Trypsin

F/Y peak intensity

Winters et al., Farad. Discussions, 2017

GOLD NANODOMES OFFER A COMPROMISE BETWEEN ENHANCEMENT AND ACCESSIBILITY.

Average enhancement factor: 10^7

Winters et al., Analyst 2015

SERS ENABLES TIME-RESOLVED MEASUREMENT OF TRYPSIN ACTIVITY.

No Trypsin

Trypsin concentration:

- 0.2 µg/ml
- 0.2 µg/ml
- 0.5 µg/ml
- 1.0 µg/ml

Trypsin Addition

Winters et al., Analyst 2015

NANODOMES ARE FABRICATED IN A CONTROLLED MANNER AND ON A LARGE SCALE.

Winters et al., Analyst 2015


SPECIFICITY OF RAMAN SIGNALS ENABES MULTIPLEXING MEASUREMENTS.

Protease 1:

Protease 2:

Winters et al., Analyst 2015

LAB-ON-A-CHIP PLATFORM OFFERS SEVERAL ADVANTAGES OVER CONVENTIONAL RAMAN MICROSCOPES.



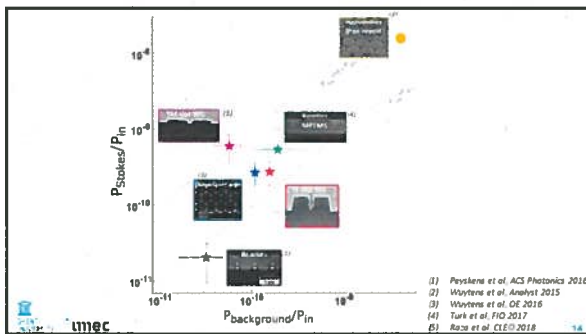
- Smaller
- Easier to handle
- Cheaper

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CONCLUSIONS

- **Generic label-free** method for monitoring protease activity.
- Allows **multiplexing** measurement of different proteases.
- **Ratio-based metric** robust to non-specific cleavage, ligand exchange and signal variations.

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Nina Turk
PhD student

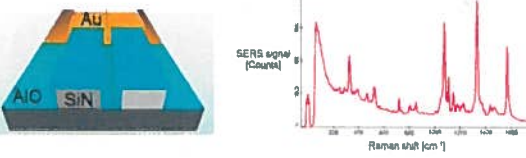
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PLASMONIC SLOT WAVEGUIDE PROVIDES HIGH SERS ENHANCEMENT FACTOR ON A CHIP.



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**PHOTONICS FOR DIAGNOSTICS AND
THERAPY 2 (Camargue Hall)**

Chair: Charles Camp

**LASERS IN BIOLOGY AND DIAGNOSTICS
(Mimosa Hall)**

Chair: Jean Olivier Durand

Selected oral communications (10+5 min)

15:00

**Towards multiplexed SERS-based on-chip
detection of protease activity (17)**

Nina Turk | Photonics Research Group,
INTEC, Ghent University – imec, Belgium

15:15

**Non-invasive detection of calcium
hydroxyapatite and calcium oxalate deep
inside biological tissue using Transmission
Raman Spectroscopy (18)**

Adrian Ghita | School of Physics and
Astronomy, University of Exeter, UK

15:00

**Optical stimulation of sensory neurons
by infra-red laser light (19)**

Fabrice Bardin | Université de Nîmes,
France

15:15

**Cell death response induced by
photosensitizer-free photoactivation of
singlet oxygen (20)**

Hélène Moulet | Laboratoire de
Physique des Lasers, Atomes et
Molécules, Université de Lille, France

Afternoon Sessions (Camargue Hall)

15:30

Round table : Education in biomedical photonics

Erasmus Mundus master in molecular nano- and biophotonics -MONABIPHOT

Ledoux-Rak Isabelle | LPQM, CNRS ENS Paris Saclay, Centrale Supélec,
Cachan, France

**Master of Science in Medical Photonics at the Friedrich Schiller University
Jena**

Jürgen Popp | Leibniz IPHT Jena, Germany

16:30 – 17:00

Industrial section on photonic technologies
Opton Laser | Alpha Nova | Toptica

16:30 – 17:30

WITEC Workshop
**Current trends in 3D Raman imaging:
New tools for research and
development**
Philippe Ayasse

17:00

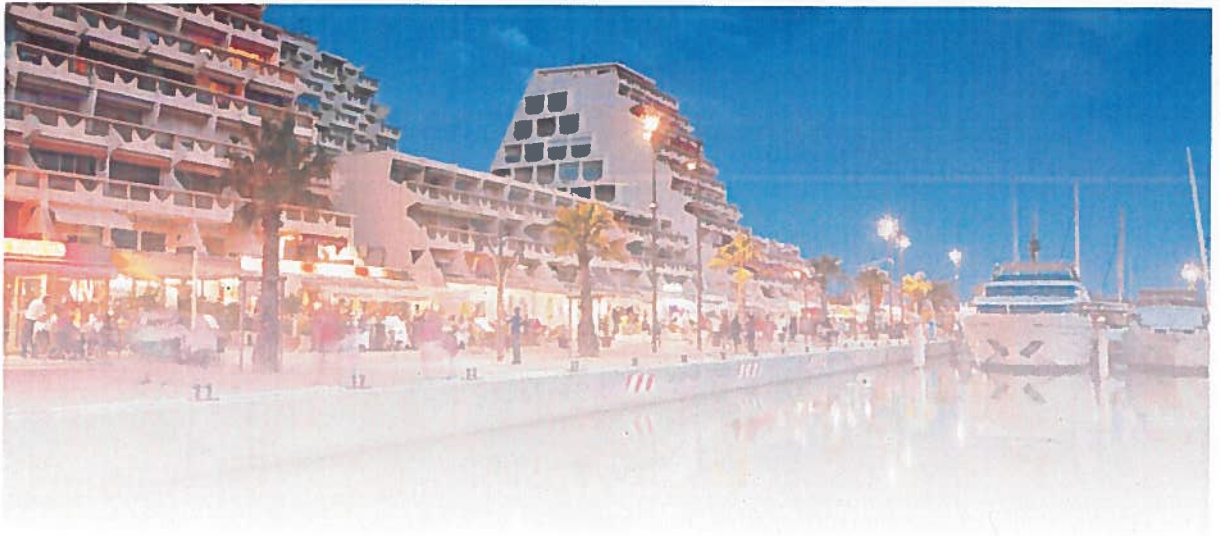
Coffee break

17:30

General Assembly

18:30

Conference leave



International Conference on BioMedical Photonics

La Grande Motte | France
16-17 March 2018

<http://biomedicalphotonics.org>