bionand
Andalusian Centre for Nanomedicine & Biotechnology

JUNTA DE ANDALUCIA

UNIVERSIDAD DE MÁLAGA

# BIONAND 2015 CONFERENCE SERIES

## "Clinical spectroscopic diagnostics: The potential of Raman spectroscopy for diagnosing infectious diseases"


**Dr. Ute Neugebauer**

*(Center for Sepsis Control and Care, Jena University Hospital;*
*Leibniz Institute of Photonic Technology;*
*InfectoGnostics Forschungscampus; Jena, Germany)*


**Host**
Xavier Le Guevel

***October 23, 12.00-13.00***
***Richard Feynman Conference Hall***
***BIONAND***


**Severo Ochoa 35. Parque Tecnológico de Andalucía**
**Málaga · Spain**
**Tel.: 952 367 600**
**www.bionand.es – gestionproyectos@bionand.es**



GOBIERNO DE ESPAÑA · MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

Unión Europea
Fondo Europeo de Desarrollo Regional
"Una manera de hacer Europa"

# *Clinical spectroscopic diagnostics: The potential of Raman spectroscopy for diagnosing infectious diseases.*

Ute Neugebauer [1,2,3]

[1] Center for Sepsis Control and Care, Jena University Hospital, Germany
[2] Leibniz Institute of Photonic Technology, Jena, Germany
[3] InfectoGnostics Forschungscampus Jena, Germany

Infectious diseases are a leading cause of death world wide. The primary cause of death from infection is sepsis. It occurs when the body's response to an infection damages its own tissues and organs. [1] Successful treatment of infection relies on timely identification of the focus, the pathogen and its antibiotic resistance pattern in order to select the appropriate antibiotic treatment as early as possible. Reliable methods speeding up the currently established cultivation-based microbiological analysis as well as methods to stratify the patients are of utmost interest.

Raman spectroscopy as a label-free and non-destructive technique holds a high potential for the spectroscopic characterization of infection. Cultivation-independent Raman-based identification methods require capturing of the bacteria in the laser focus. This can be achieved using dielectrophoresis [2] or centrifugal forces on a lab-on-disc microfluidic platforms [3]. With both approaches pathogens can be identified directly from body fluids within a few minutes including sample preparation as demonstrated for urine samples from patients suffering from urinary tract infections. In times of rising antibiotic resistances, also the antibiotic susceptibility of the pathogen has to be determined. Exemplarily, the spectroscopic analysis of the drug-target interactions of vancomycin, a glycopeptide antibiotic, with enterococci is presented. Changes in the bacterial Raman spectra due to antibiotic treatment can be identified already after 30 minutes of treatment. [4] Results from this study have been implemented in an algorithm for the fast detection of vancomycin resistant enterococci (VRE) [5].

Not always bacteria are residing in body fluids, but they can hide within cells and cause difficult-to-treat intra-cellular infections. An advanced Raman-based approach is presented to localize and characterize intracellular *Staphylococcus aureus* in three dimensions without the need of any external label [6].

An indirect method to diagnose infections, involves assessment of the host response upon pathogen invasion by recording a hemogram. Here, the first steps towards a spectroscopic hemogram will be presented [7].

***Acknowledgement***

Financial support by the BMBF (CSCC, FKZ 01EO1002 and FKZ 01EO1502), by the DFG (FOR 1738) and the EU (HemoSpec, CN 611682) is highly acknowledged.

***References***

[1] World Sepsis Day, http://www.world-sepsis-day.org.
[2] U. Schröder, A. Ramoji, U. Glaser, S. Sachse, C. Leiterer, A. Cszaki, U. Huebner, W. Fritsche, W. Pfister, M. Bauer, J. Popp, U. Neugebauer Anal. Chem., 2013, 85, 10717−10724
[3] U.-Ch. Schröder, F. Bokeloh, M. O'Sullivan, U. Glaser, K. Wolf, W. Pfister, J. Popp, J. Ducreé, U. Neugebauer Biomicrofluidics 2015, 9, 044118.
[4] C. Assmann, J. Kirchhoff, C. Beleites, J. Hey, S. Kostudis, W. Pfister, P. Schlattmann, J. Popp, U. Neugebauer, Anal. Bioanal. Chem. 2015, DOI 10.1007/s00216-015-8912-y.
[5] U.-Ch. Schröder, C. Beleites, C. Assmann, U. Glaser, U. Hübner, W. Pfister, W. Fritzsche, J. Popp, U. Neugebauer: Scientific Reports 2015, 5, 8271.
[6] C. Große, N. Bergner, J. Dellith, R. Heller, M. Bauer, A. Mellmann, J. Popp, U. Neugebauer, Analytical Chemistry 2015, 87, 2137-2142.
[7] A. Ramoji, U. Neugebauer, T. Bocklitz, M. Foerster, M. Kiehntopf, M. Bauer, J. Popp: Toward a spectroscopic hemogram: Raman spectroscopic differentiation of the two most abundant leukocytes from peripheral blood. Anal Chem. 2012, 84(12), 5335-5342.