Biophotonics – the solution to pressing unmet medical needs!?

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Substantial demographic changes in recent years created new unmet medical challenges around the world including neurodegenerative diseases, cancer, cardiovascular diseases, infectious diseases, etc. To better understand, treat or even cure these diseases, an urging demand for new clinical solutions for both an efficient, early diagnosis and targeted therapy are urgently needed. In the past few years, biophotonics has witnessed the development of methods and technologies that are potentially in a position to offer a solution to solve these current unmet medical needs. In this regard, spectroscopic methods like e.g. fluorescence and Raman spectroscopy are particularly noteworthy. Here, we will summarize our latest achievements towards the development and application of photonic in particular Raman spectroscopic approaches according to unmet medical needs of pathology, oncology, and infection/ sepsis.

We will particularly highlight our recent work towards the application of Raman spectroscopy as point-of-care approach for the fast identification of pathogens, their antibiotic resistances and the specific host. The great capacity of Raman spectroscopy in combination with innovative chemometric strategies and chip-based sampling approaches to address these challenging tasks will be presented. Furthermore, it will be shown that the combination of Raman approaches with other spectroscopic technologies provides a sensitive and selective tool to potentially solve challenges currently faced by clinical pathology. We introduce among others a compact CARS (coherent anti-Stokes Raman scattering) /SHG (second harmonic generation)/ TPEF (two-photon excited auto fluorescence) multimodal nonlinear microscope for use in clinics. The potential of this multimodal imaging approach together with advanced image analysis routines to overcome current limitations of frozen section analysis with respect to achieving a reliable intraoperative tumor margin detection will be highlighted.

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Juergen Popp studied chemistry at the universities of Erlangen and Würzburg. After his PhD in Chemistry he joined Yale University for postdoctoral work. He subsequently returned to Würzburg University where he finished his habilitation in 2002. Since 2002 he holds a chair for Physical Chemistry at the Friedrich-Schiller University Jena. Since 2006 he is also the scientific director of the Leibniz Institute of Photonic Technology, Jena. His research interests are mainly concerned with biophotonics. In particular his expertise in the development and application of innovative Raman techniques for biomedical diagnosis should be emphasized. He has published more than 630 journal papers and has been named as an inventor on 12 patents in the field of spectroscopic instrumentation. He is founding editor and Editor-in-Chief of the Journal of Biophotonics. In 2012, he received an honorary doctoral degree from Babeş-Bolyai University in Cluj-Napoca, Romania. Professor Jürgen Popp is the recipient of the 2013 Robert Kellner Lecture Award and the prestigious 2016 Pittsburgh Spectroscopy Award. In 2016 he was elected to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows.