Raman spectroscopy - a powerful tool for targeting the unmet medical need

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Within the last years, Raman spectroscopy developed from a niche technology in analytical chemistry to a versatile biomedical analysis tool. The ability to obtain molecular fingerprint information labelfree makes Raman spectroscopy attractive for many applications in clinical diagnostics of bodily fluids, pathogens, cells, and tissue. This presentation reports about Raman spectroscopic approaches for the diagnosis and therapy of infectious diseases and for spectral histopathology [1,2].

Faster and more detailed diagnosis of acute life-threating human infections (like e.g. sepsis) represents an important unmet medical need. It will be shown that Raman spectroscopy holds great promise as point-of-care approach for a fast identification of pathogens and the determination of their antibiotic resistances, which is crucial for patient's survival. In this context, we will present innovative chip-based bacterial isolation strategies out of complex sample matrices (e.g. blood or urine) [3-8].

The second part of this presentation reports about the Raman spectroscopic detection of tissue pathologies. Here, the medical focus predominantly lies on the determination of the tumor type and grade and a better delineation of tumor margins. In this context, it will be shown that the combination of Raman approaches with other spectroscopic technologies is very beneficial for addressing the aforementioned unmet medical needs. We will introduce among others a combined Raman /FLIM (fluorescence lifetime imaging microscopy) fiber optical probe for in-vivo tissue screening [9]. Furthermore we demonstrate how the combination of CARS (coherent anti-Stokes Raman scattering), SHG (second harmonic generation) and two-photon excited autofluorescence (TPEF) enables the characterization of the morphochemistry of frozen section biopsy specimens [10-15].

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References

[1] Eberhard, K. Stiebing, C. Matthäus, C, Schmitt, M. Popp, J., *Expert Rev. Mol. Diagn.* **15**, 773 (2015).
[2] Krafft, C. Schie, I.W. Meyer, T. Schmitt, M. Popp, J., *Chem. Soc. Rev.* **45**, 1819 (2016).
[3] Kloß, S. Kampe, B. Sachse, S. Rösch, P. Straube, E. Pfister, W. Kiehntopf, M. Popp J., *Anal. Chem.* **85**, 697 (2013).
[4] Schröder, U. -Ch. Beleites, C. Assmann, C. Glaser, U. Hübner, U. Pfister, W. Fritzsche, W. Popp, J. Neugebauer, U., *Scientific Reports*, **5**, 8217 (2015).
[5] Große, C. Bergner, N. Dellith, J. Heller, R. Bauer, M. Mellmann, A. Popp, J. Neugebauer, U., *Anal. Chem.* **8**, 2137 (2015).
[6] Kloß, S. Rösch, P. Pfister, W. Kiehntopf, M. Popp J., *Anal. Chem.* **87**, 937 (2015).
[7] Pahlow, S. Kloß, A, Blättel, V. Kirsch, K. Hübner, U. Cialla, D. Rösch, P. Weber, K. Popp, J., *ChemPhysChem*, **14**, 3600 (2013).
[8] Schröder, U. C. Ramoji, A. Glaser, U. Sachse, S. Leiterer, C. Cszaki, A. Huebner, U. Fritsche, W. Pfister, W. Bauer, M. Popp, J. Neugebauer, U., *Anal. Chem.* **85**, 10717 (2013).
[9] Dochow, S. Ma, D. Latka, I. Bocklitz, T. Hartl, B. Bec, J. Fatakdawala, H. Marple, E. Urmey, K. Wachsmann-Hogiu, S. Schmitt, M. Marcu, L. Popp, J., *Anal. Bioanal. Chem.* **407**, 8291 (2015).
[10] Meyer, T. Baumgartl, M. Gottschall, T. Pascher, T. Wuttig, A. Matthaeus, C. Romeike, B. F. M. Brehm, B. R. Limpert, J. Tuennermann, A. Guntinas-Lichius, O. Dietzek, B. Schmitt, M. Popp, J., *Analyst*, **138**, 4048 (2013).
[11] Meyer, T. Guntinas-Lichius, O. von Eggeling, F. Ernst, G. Akimov, D. Schmitt, M. Dietzek, B. Popp, J., *HEAD & NECK*, E280 (2013).
[12] Heuke, S. Vogler, N. Meyer, T. Akimov, D. Kluschke, F. Röwert-Huber, H.-J. Lademann, J. Dietzek, B. Popp, J., *British Journal of Dermatology*, **169**, 794 (2013).
[13] Heuke, S. Chernavskaia, O. Bocklitz, T. Bekele Legesse, F. Meyer, T. Akimov, D. Dirsch, O. Ernst, G. v. Eggeling, F. Petersen, I. Guntinas–Lichius, O. Schmitt, M. Popp, J., *HEAD & NECK*, **38**, 1545 (2016).
[14] Chernavskaia, O. Heuke, S. Vieth, M. Friedrich, O. Schürmann, S. Atreya, R. Stallmach, A. Neurath, M. F. Waldner, M. Petersen, I. Schmitt, M. Bocklitz, T. Popp, J., *Scientific Reports*, **6**, 29239 (2016).
[15] Bocklitz, T. W. Salah, F. S. Vogler, N. Heuke, S. Chernavskaia, O. Schmidt, C. Waldner, M. J. Greten, F. R. Bräuer, R. Schmitt, M. Stallmach, A. Petersen, I. Popp, J., *BMC Cancer*, **16**, 534 (2016).