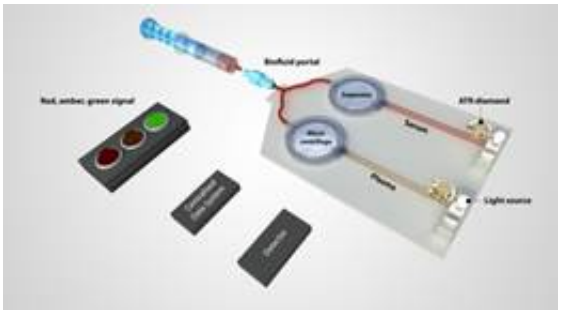
Vibrational spectroscopy of biofluids opens new paths to disease screening and diagnosis

April 9 2014, by K. Maedefessel-Herrmann



In today's ageing population, resulting in a rising prevalence of chronic diseases such as neurodegeneration, the need for simple, non-invasive methods to diagnose or screen for important medical conditions becomes more and more relevant. Objective and cost-effective approaches capable of diagnosing early-stage disease in point-of-care clinical settings are necessary to facilitate the personalising of therapies to prevent or slow down pathology development.

Vibrational spectroscopy, IR or Raman spectroscopy, could be the base for such kind of approach, as they provide several advantages: Sample preparation is minimal, no reagents are required, the techniques involved are relatively low-cost, data frameworks are available, a profile of spectral alterations can be determined, and the methods are suitable for automation. Yet, in the handling of some biofluids such as blood, there

remain challenges to be overcome.

In a review article, a team at Lancaster University led by Pierre Martin-Hirsch explores the evidence supporting the applicability of techniques based on vibrational spectroscopy to generate spectral biomarkers of disease in biofluids such as plasma or serum.

The authors conclude that vibrational spectroscopy, especially attenuated total reflection (ATR)-FTIR spectroscopy, shows a high sensitivity to identify low-level effects that may lead to transformation (a precursor of malignancy). Computational algorithms allow one to classify according to cell type or phenotype, even when diagnosing biofluids. In addition, they open up the possibility to extract discriminating features that may give rise to a new concept of spectral biomarkers. "This inter-disciplinary approach will require a major mind-set change in translational research, which traditionally understands alterations in gene expression or protein levels as biomarker endpoints", Martin-Hirsch and his co-authors state. "Harnessing these methods as in surface-enhanced Raman spectroscopy (SERS) to more conventional approaches might facilitate this transition." They hope, that, once these methods are established within tertiary care, there may be scope for moving into general practice and primary care with the design of hand-held devices that could be used to identify patients requiring referral to tertiary care for more definitive investigations and diagnosis.

Although this concept may seem very far removed from current clinical practice, the authors observed various protocols and designs that may, to their opinion, provide a starting point for such an idea to become a reality. A microfluidic platform hypothesized by the authors could, combined with an appropriate lightsource, revolutionize screening in the 21st century.

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Martin, P. L Martin-Hirsch, "Vibrational spectroscopy of biofluids for disease screening or diagnosis: translation from the laboratory to a clinical setting," *J. Biophotonics* 7:3-4, 167-179 (2014); DOI dx.doi.org/10.1002/jbio.201400018

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