High-throughput Raman Spectroscopy of Single Cells

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In recent years there have been a significant number of novel and promising biomedical and clinical applications using Raman spectroscopy [1]. Specifically label-free single cell analysis has shown interesting opportunities for biomedical research [2,3]. It was shown that not only can eukaryotic cells can be identified label-free, but also the interaction of drugs on cells can be investigated. While many publications have shown very intriguing results, the implementations suffer from distinct problems, which hamper a broader implementation of this method. Due to the complex data acquisition procedure the experiments are usually performed on a very small number of cells, typically on the order of hundred cells, and rarely on mixed populations [4]. This, however, results questionable statistical results and makes the experiments difficult to translate to real world scenarios.

We have addressed this problem by implementing a fully automated data acquisition approach, which allows the measurement of thousand of cells in a short time. This implementation results in many new and exciting applications. The new approach was applied to perform a label-free white blood cell differentiation and showed comparable results to standard machine counting methods; with Raman-measurements performed on more than 20,000 cells. Furthermore, the setup was successfully tested for a rapid time series of drug cells interaction measurements, and the identification of tumor cells in a mixture with background cells. These results will be presented.

Acknowledgments: This work is supported by the EU-funded project MIB (No 667933) the European Union within the FP7 collaborative project CanDo (610472) and by the Leibniz Association through the project Hyperam (SAW-2016-IPHT-2).

References

[1] C. Krafft, I. W. Schie, T. Meyer, J. Popp, Chem. Soc. Rev. (2015**)**, DOI 10.1039/c5cs00564g.
[2] I. W. Schie, L. Alber, A. L. Gryshuk, J. W. Chan, Analyst 139, 2726–2733 (2014).
[3] I. W. Schie, R. Kiselev, C. Krafft, J. Popp, Analyst 141, 6387–6395 (2016).
[4] C. Beleites, U. Neugebauer, T. Bocklitz, C. Krafft, J. Popp, Anal. Chim. Acta 760, 25–33 (2013).