A Novel Combination of Dielectrophoresis and Raman Spectroscopy for the Characterization and Identification of Bacteria Directly in Body Fluids

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A novel sensitive and rapid method based on dielectrophoresis and Raman spectroscopy is presented, which is able to collect high quality Raman spectra from bacteria directly in dilute suspensions. This method holds the potential to reduce diagnosis time in medicine by orders of magnitude.

Dielectrophoresis is the translational movement of dielectric particles in a non-uniform electric field and is used to collect and keep bacteria from dilute suspensions in well-defined micro-sized regions. Micro-Raman spectroscopy then is used to analyze the molecular signature of these captured bacteria. Finally multivariate statistical data analysis i.e. principal component analysis and linear discriminant analysis are used to setup a robust statistical model for the classification and identification of different species.

In a proof-of-principle study, the three pathogens *Escherichia coli*, *Enterococcus faecalis* and *Enterococcus faecium*, which are commonly encountered in urinary tract infections, are suspended in PBS buffer solution. Within a few minutes those bacteria are dielectrophoretically captured, Raman spectroscopically characterized and identified. Furthermore the method is applied to real world samples i.e. patient's urine samples to identify *E. coli* and *E. faecalis* within one hour. In contrast, standard microbiological methods, which require time consuming cultivation steps, are taking at least 24 to 48 hours to obtain the result.

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