DETECTION OF BACTERIAL CELLS AND SPORES BY SERS: TOWARDS THE AUTOMATED RAPID ANALYSIS

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Abstract

Bacterial pathogens are especially dangerous when airborne. Active cells in aerosolized water or dry spores can induce the rapid transmission of diseases. In such cases, counter-epidemic measures must be based on rapid diagnostics of the evolving pathogen.

Immunochemical assays demand the supply of antibodies, which make the rapid detection of multiple pathogens very complex and expensive. Modern genomic methods of bacteria identification can provide the reliable identification of vast majority of known bacteria and their spores, but suffer from the high analysis cost. Thus, rapid detection of bacterial pathogens has to be the antibody-independent chemical assay.

Raman spectroscopy of bacteria provides the fingerprint-quality spectra that can be used for the identification of bacterial genera [DOI:10.1039/b705973f, DOI:10.1039/c2an35448a]. However, normal Raman spectroscopy of bacteria is complicated by the fact that bacterial cells and spores are very weak Raman scatterers, and significant enhancement of bacterial spectra and spectra processing are needed for the reliable identification [DOI:10.1366/10-06173, DOI:10.1111/j.1745-4581.2008.00131.x].

In our work, we obtain SERS spectra of Gram(+) and Gram(-) bacteria either on reference aluminum foil substrates or on aluminosilicate substrates based on halloysite ceramic nanotubes. Aluminosilicate filtering materials could be exploited for the accumulation of biomaterial form air or water for the subsequent SERS analysis. Spectra of bacterial active cells and spores obtained on the Raman peak-free substrates could be processed automatically, thus opening the possibility of automated rapid detection of airborne pathogens.

Keywords: Surface-enhanced Raman spectroscopy, bacteria, spores, chemotaxonomy, automated spectra processing

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