APPLICATION OF RAMAN SPECTROSCOPY FOR ANALISYS OF POLLEN

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The prevention of bioterrorism attacks is a global challenge that researchers try to face with a large variety of methods and techniques. That problem has significantly increased the attention on the rapid detection and identification of the bioaerosol, intended as the airborne .biological particles ranging from pollen, to bacteria and viruses (50 μm to 100 nm). Therefore a rapid and really preventive monitoring needs techniques with some specific features as well as no sample preparation, precision of the measurement to identify properly the samples, fast answer capabilities, preferably on-line, and high sensitivity that enables working even on single cells. Methods based on Raman spectroscopy can potentially meet these requirements [1,2].
In the UTAPRAD-DIM Laboratory of the ENEA center of Frascati, a laboratory with a large expertise in the field of laser spectroscopy, a work on the detection and identification of biological agents in aerosol by Raman spectroscopy has been started. With the final goal to design a system for the rapid detection of hazardous bacteria, micro-Raman analysis have being carried out on interferences and simulants of bacteria in air. In order to detect and characterize various parts of aerosol as well as interfering fraction, in this first phase a collection of pollens have been studied by the means of a micro-Raman system, working with an excitation wavelength of 785 nm and power up to 300 mW and equipped with 3 magnifications (10x, 20x, 40x).
In spite of the advantages the Raman spectroscopy can offer, unfortunately it suffers from a very low cross section that makes Raman signal difficult to record and to analyze, all the more when just some sample cells are available and analysis times have to be very fast. To overcome this problem the spectra have been analyzed by a fuzzy identification algorithm, able to recognize known substances in Raman spectra. The algorithm has been developed to avoid the use of the euclidean distance as indicator of closeness between the sample and the reference spectra. Moreover, the use of a wavelet transform allows the algorithm to work down to signal-to-noise ratios of 1 with low attribution errors.

[1] K. Maquelin, L.P. Choo-Smith, H.P. Endtz, H.A. Bruining, and G.J. Puppels, J Clin Microbiol. 40 (2002) 594–600.
[2] N.P. Ivleva, R. Niessner, U. Panne, Anal. Bioanal. Chem. 381 (*2005)* 261-267.