The usage of Raman spectroscopy in the identification of cellular systems

D. Franco[1], E. Fazio[2], A. Allegra[3], M.S. Nicolò[1], F. Neri[2], S. Trusso[4], C. Musolino[3], S.P.P. Guglielmino[1]

[1]*Dip.to di Scienze Biologiche e Ambientali, Università di Messina – dfranco@unime.it*
[2]*Dip.to di Fisica e di Scienze della Terra, Università di Messina*
[3]*Dip.to di Chirurgia generale, Oncologia e Anatomia Patologica, Università di Messina*
[4]*CNR-Istituto per i Processi Chimico-Fisici Sede di Messina*

Abstract

In this contribution, the identification and characterization of eukaryotic and bacterial cells, and viral structures through the Raman fingerprint are presented and discussed. Raman spectroscopy is a technique largely used for the structural characterization of materials. Particularly, Surface-Enhanced Raman Spectroscopy (SERS) overcomes the limitations of traditional Raman spectroscopy by using Raman-active analyte molecules that have been adsorbed onto prepared nanostructured metal surfaces. SERS enhances the Raman signal intensity which enables the technique to be sensitive enough to detect single molecule. Nowadays, Raman technique represents an interesting analytical tools for biomedical field since, besides other more conventional techniques, it can give additional chemical informations, such as discriminate among normal or tumoral cells. Raman technique, in fact, can be performed without any sample contamination as no fluorescent markers are needed in order to investigate the cellular system. The investigated cells were treated and fixed on CaF_2 slides and on Ag and Au nanostructured substrates following a well defined protocol. Ag and Au substrates were prepared by means of pulsed laser ablation [1,2]. The study of included microstructures as well as the presence of intra-cellular effects are reported. Moreover, the adopted preparation and characterization approach allows to follow the differences in the cellular systems in terms of structure/composition, highlighted also by statistical tools like Principal Component Analysis. Finally, we show preliminary results about Raman identification of circulating malignant cells which represents a promising result to allow early diagnosis or minimal residual disease detection.

Acknowledgments
Authors knowledge A.B.A.L. onlus Messina (http://www.abalmessina.it) for the use of the XploRA Raman spectrometer.

[1] E. Fazio, F. Neri, C. D'Andrea, P. M. Ossi, N. Santo, S. Trusso, J. Raman Spectrosc. 2011, 42, 1298–1304.
[2] N. R. Agarwal, E. Fazio, F. Neri, S. Trusso, C. Castiglioni, A. Lucotti, N. Santo, P. M. Ossi, Cryst. Res. Technol. 46, No. 8, 836 – 840 (2011).