Analysis of cancer cell membrane by surface enhanced Raman spectroscopy

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Raman spectroscopy has become in recent years an important analytical and research tool in bioscience. The inherent weakness of spontaneous Raman signals represents the main limit for detecting analytes at low concentration. This drawback can be, at least partially, overcome by using Surface-Enhanced Raman Spectroscopy (SERS) [1].
SERS is based on localized surface plasmon resonances induced by visible optical fields in metal nanostructured materials. The most peculiar features of this technique are: i) the huge amplification of inelastic Raman photons (by as much as 6 to 12 orders of magnitude, which even allows detection of single molecules) and ii) the strong distance dependence of the near-field effect (~10-20 nm) which make effective SERS signal only for molecules in proximity to the metal surface. Both characteristics make SERS ideally suited for the study of cell membranes [2]. As a matter of facts, the possibility to highlight the contribution of the cytoplasmic membrane from the other cellular compartments opens many opportunities to analyze the role of specific biomolecules in healthy and pathological cells, as demonstrated in recent papers [3,4].
Herein, we propose to use our SERS substrates for the analysis of cancer cells. In particular we focus on the role of carbonic anhydrases (CA-IX), a transmembrane enzyme that is induced by tissue hypoxia. The investigation was performed on SK-OV-3 cells, genetically transfected to over-express CA-IX, so mimicking a malignant cell transformation. For SERS analysis, cells were transferred over a glass coverslip and therefore gently brought in contact with a SERS substrate lied down on cells. Since transfection can affect not only the cellular membrane but also inner cellular compartments, SK-OV-3 cells were also analyzed by spontaneous Raman spectroscopy. Both SERS- and spontaneous-Raman data were analyzed by Principal Component Analysis. Preliminary results seem to suggest an higher efficiency of SERS data in detecting the overexpression of CA-IX in modified cells.

References

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