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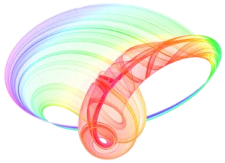

PHOTONICA2019

The Seventh International School and Conference on Photonics, 26 August – 30 August 2019, Belgrade, Serbia

& Machine Learning with Photonics Symposium (ML-Photonica 2019)

& ESUO Regional Workshop

& COST action CA16221

Editors: Milica Matijević, Marko Krstić and Petra Beličev

Belgrade, 2019

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Effects of cerium-dioxide nanoparticles in cervical cancer cells studied by Raman spectroscopy

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Study of the interaction between nanoparticles and human cells is usually performed using customized biochemical assays that mostly offer measurements of a single quantity/property and use labels. Raman spectroscopy on the other hand offers integral insight into complex information on biomolecular composition and molecule conformation inside cells by measuring vibrational spectra from the entire cell [1]. Furthermore, it does not require dyes nor other labels and sample preparation is very simple, which reduces time consumation and possibility of cell damage during preparation.

Cerium-dioxide (CeO_2) nanoparticles are known for their controversial dual activity in numerous studied cancer cell lines: while protecting some cell types from oxidative damage, their cytotoxic effect in other cell lines is also reported [2, 3]. Here, effects of two types of CeO_2 nanoparticles: uncoated and dextran-coated, were studied in HeLa cells, a cervical carcinoma derived cell line. Nanoparticle-treated cells were probed by routinely used biological assays for cell growth and viability, based on dying with Sulforhodamine B and Trypan Blue, respectively [3]. The tests have shown that the nanoparticles have more prominent effect on cell growth than on viability. In the light of this information Raman spectroscopy was employed in order to investigate the changes in biomolecular content of the cervical cancer cells after treatment with nanoparticles and find connection between these changes and the resulting cell status. Raman spectra of nanoparticle-treated and control (untreated) cells were obtained using 532 nm laser line as an excitation probe. From each experimental group, at least 250 cell spectra were measured. Principal component analysis (PCA) covering the spectral regions (700-1800) cm^{-1} and (2800-3200) cm^{-1} has extracted the differences between vibrational spectra features of nanoparticle-treated and control cells, but also between spectra of cells treated with uncoated and coated CeO_2 nanoparticles. These changes have been associated with induced alterations of prominent groups of biomolecules, DNA, lipids and proteins. Reduced total DNA content and/or breaking of O-P-O bonds leads to the decreased vibrational intensity of 785 cm^{-1} peak which differentiates to a large degree treated and control cells. Amide I vibrational band (1600-1670) cm^{-1}, characteristic for peptide bonds and modulated by proteins secondary structure, differentiates between cells treated with coated and uncoated nanoparticles. Correlation of the spectral information with the results of biological assays was performed.

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