# INVESTIGATIONS ON DIFFERANCES BETWEEN NORMAL AND CANCEROUS CELLS BY MEANS OF ATOMIC FORCE MICROSCOPY AND TIME-OF-FLIGHT SECONDARY ION MASS SPECTROMETRY

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## Introduction

In present times, neoplastic diseases become one of the major causes of deaths. The process of cancerogenesis is still incomprehensive. That is why the investigations on biomechanics of cancerous cells in search of alterations between different grades of malignancy seem to be useful for the development of new cancer therapies. In this study mechanical properties and a chemical composition of different cancerous cell lines have been analyzed in order to find its correlation with the state of cells (non-metastatic or metastatic one). Two types of cancer have been studied: human bladder cancer and melanoma (four cell lines with different grades of malignancy for both types).

## Methods

Atomic Force Microscopy (AFM) is a one of the techniques that offers the opportunity to examine surface topography of living cells as well as to study their mechanical properties. The cancerous cell aptitude for invasion and migration has been associated with poor differentiation of the cell, including its cytoskeleton [Lekka, 2012]. Time-of-flight secondary ion mass spectrometry (TOF-SIMS) is an excellent tool for examination of chemical compositions of various materials. This technique is based on the mass spectroscopic analysis of ions, which are generated by the interaction of a primary ion beam with a sample. As SIMS experiments have to be carried out in high vacuum, biological samples like cells require special treatment [Malm, 2009].

## Results

By means of AFM imaging of the topography of cells has been performed as well as the analysis of their elastic properties. To quantify the observed alterations, the distribution of the Young's modulus for each cell line have been created based on Atomic Force Spectroscopy measurements. For SIMS experiments the protocol for samples has been developed using chemical fixation followed by drying. High resolution SIMS mass spectra, range up to 800 Da, have been analyzed by means of Principal Component Analysis (PCA) [Jackson, 1981].

The alterations between actin filaments organization in the cytoskeletons of cells with different grades of malignancy have been observed in AFM topography images. Also the analysis of the average Young's modulus values shows differences between malignant and non-malignant cells. Metastatic cells have lower Young's modulus values than non-metastatic ones. In this way, the resulting conclusions have been extended to the cytoskeletal structures inside the cell and their biomechanical properties. The analysis of mechanical properties of living cells has been compared with the study of their chemical composition [Malm, 2009]. The PCA analysis of obtained mass spectra splits datasets corresponding to different cell lines. It means that SIMS experiments also have allowed to distinguish between non-metastatic and metastatic cells.

## Disscusions

The combination of two techniques, namely AFM and SIMS, enables the identification of cellular properties that could be used to identify cancerous cells. These characteristic features might indicate more invasive phenotype of cancerous cells.

## Reference

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