SR FTIR Spectroscopy Study of the Prostate Cancer (PC3) Cells Repair after Damage Induced by Protons.

A. Wiecheć, C. Paluszkiewicz, E. Lipiec, W.M. Kwiatek

Department of Experimental Physics of Complex System, Institute of Nuclear Physics PAN, Radzikowskiego 152, 31-342 Kraków, Poland

Among spectroscopic techniques, the FTIR (Fourier Transform InfraRed) spectroscopy reveals the nature of biological sample and produces spectra of compositional and structural changes at the molecular level without chemical marker [1,2].

Here, the evaluation of cellular repair capability of damage induced by protons was studied with application of SR-FTIR (Synchrotron Radiation - FTIR) spectroscopy. The results from SR-FTIR and parallel biochemical study were compared.

The single cells from prostate cancer PC3 cell line were irradiated with proton microprobe. The 2 MeV external proton beam was delivered by the Van de Graaff accelerator with the beam spot of 16 μm in diameter. The cellular irradiation response was evaluated: a) right after proton irradiation and b) after selected incubation times, allowing cells to repair the damage.

The study was performed using two methods:

a) physical - SR-FTIR spectroscopy in transmission mode with a resolution of 4 cm^{-1} in spectral range from 4000 cm^{-1} to 400 cm^{-1}. Spectral changes were analyzed in DNA region (from 1240 cm^{-1} to 950 cm^{-1}) and protein amides region (from 1800 cm^{-1} to 1400 cm^{-1}).

b) biochemical - fluorescent microscopy revealing presence of antibodies specific to DNA double strand breaks formation (γH2AX test).

Results indicate that the chemicals used in γH2AX test affect the infrared spectra shapes. The changes in the amides region suggest strong influence of anti-γH2AX monoclonal antibodies. The SR-FTIR spectra of irradiated cells show changes in chemical backbone structure of DNA correlated with incubation time after protons irradiation. These changes, particularly prominent in vibrational spectra in range from 1240 cm^{-1} to 950 cm^{-1}, potentially relate to the DNA strand breaks. The comparison of results obtained with both methods (biochemical and physical) allows further discussion, planning of future research and possible verification of this hypothesis.

References:

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[2] B. Stuart, "Biological application in infrared spectroscopy: fundamentals and applications", p. 137–163 John Wiley & Sons, Inc. (2004).

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