Application of AFM-IR to Study Human Lenses and Chromosomes

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The combination of AFM and IR techniques (AFM-IR), provides both IR - spectra on nanoscale level and topography of the samples which is given by the AFM [1]. NanoIR2 system at the Institute of Nuclear Physics PAN in Krakow, Poland enables the use of both OPO (Optical Parameter Laser) and QCL (Quantum Cascade Laser) lasers. Application of OPO and QCL lasers results in different features in the IR-spectra [2]. The presentation will describe two different applications of AFM-IR study. First example is human lens tissue. Cataract is a widespread disease, which leads to cloudy or misty vision related to the decrease of eye lens transparency [3].The use of RS, FTIR, and AFM-IR techniques make them attractive tools to characterize biological components. Fig. 1 presents the images of the healthy and cataractous human lenses at micro- and nano- scale levels along with the Amide I distribution maps. The obtained data indicate the influence of the disease development on the secondary structure of proteins and conformational changes of the amino acid residues.

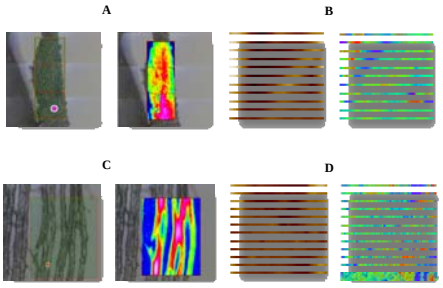

Figure 1. Microscope and AFM images of healthy (A and B) and cataractous lens (C and D) tissues, with corresponding Amide I intensity maps recorded by FTIR and AFM-IR, respectively.

The second example is human chromosomes. Theyare composed of chromatin that is a mixture of nucleic acids (DNA) and proteins (histones) [4]. QCL and OPO lasers were applied to compare AFM-IR signal. The results show enormous difference in quality and quantity of measured bands. When QCL laser was used the 1720 cm^{-1}, 1660 cm^{-1}, 1550 cm^{-1}, 1460 cm^{-1} and 1230 cm^{-1} bands were very well defined while in case of OPO laser the 1540cm^{-1} and 1460 cm^{-1}bands weren't detected.

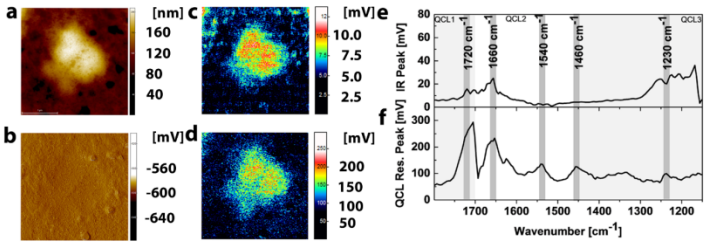

Figure 2. AFM-IR maps and spectra of single chromosome: a- AFM topography of acentric single chromosome, b- deflection signal, c- AFM-IR distribution of ν_{as} (O- P-O) 1230 cm^{-1} band, IR Peak measured using OPO laser, d- AFM-IR distribution of 1230 cm^{-1} band measured using QCL laser, averaged spectrum measured with e- OPO laser and f- QCL laser.

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