

## ***AFM-IR Spectroscopy of Human Lens at the Nanoscale Range***

**C. Paluszkiwicz<sup>a</sup>, P. Chaniecki<sup>b</sup>, M. Rękas<sup>c</sup>, W. M. Kwiatek<sup>a</sup>**

<sup>a</sup> Institute of Nuclear Physics Polish Academy of Sciences, PL-31342 Krakow, Poland

<sup>b</sup> 5th Military Hospital with Polyclinic, PL-30091 Krakow, Poland

<sup>c</sup> Military Medical Institute, PL-04141 Warszawa, Poland

The point of our study was to analyze human lenses with cataract and find out the changes depending of illness level. Cataract is mostly associated with the age of patient and decreasing the transparency of lenses caused by the change of its chemical structure and phase composition. In order to solve the problem the surgical operation is required to remove the cloudy lens and replaced it by the eye lens polymer. The dynamic development of ophthalmic surgery methods enabled the introduction of modern operative techniques, nevertheless complicated cataract removal remained a challenge for operators. One of constantly performed methods of subluxated cataract removal in peculiar cases is cryoextraction. Extraction of the lens as a whole provides a broad spectrum of possibilities to analyze both physical and chemical properties of cataractous lens.

In this work experimental materials were obtained from the lens removed during surgical intervention from a 60 year old female patient, urgently admitted to the Clinic in Warsaw in order to undergo a cataract surgery of the right eye. The patient in ophthalmological history reported high myopia, the wear of glasses since childhood and no ocular surgeries. Patient's overall status included history of diabetes mellitus and hepatitis C treatment. The cataractous lens was extracted with the cryoprobe.

The sample was cryo sectioned and prepared as a 10  $\mu\text{m}$  thick section placed on: Mylar foil,  $\text{CaF}_2$  windows and the adjacent section was placed on microscopic glass for histopathology examination. 2D FTIR map was performed using the Thermo Scientific™ Nicolet™ iN™10 MX Infrared Imaging Microscope in transmission mode with 6  $\mu\text{m}$  spatial resolution. Matrix detector was used in this case. AFM-IR measurements were done using NanoIR2 Anasys instrument. Atomic force microscopy (AFM) can provide information on the morphology and mechanical properties of the species while the infrared spectroscopy (IR) can describe changes in protein secondary structure.

In our study it was important to analyze the relations between bands in the region of 1000  $\text{cm}^{-1}$  to 1900  $\text{cm}^{-1}$ . Such a requirement had been proved by Shan-Yang Lin et al. who analyzed lenses by vibrational spectroscopy. Our results indicate that the  $\beta$ -sheet structure was a predominant component in Amid I.

This project has been supported by the National Science Centre Poland under decision no. DEC-2012/05/B/ST4/01150. The research has been also carried out under the project co-funded by the Malopolska Regional Operational Program Measure 5.1 Krakow Metropolitan Area as an important hub of the European Research Area for 2007-2013.

### References:

- [1] S.-Y. Lin, M.-J. Li, C.-J. Ho, *Graefe's Arch Clin Exp Ophthalmol.* 237, 157-160 (1999).
- [2] A. Dazzi, *Appl. Spectroscopy* 66, 1365-1384 (2012).
- [3] A. Rahim, K. Iqbal, *J. Pak Assoc.* 61, 853-855 (2011).