

NEXAFS study of selected natural biopolymers

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NEXAFS is a modern powerful tool, which allows probing the atomic composition and angular-momentum-character specific densities of unoccupied electronic states and may give information about chemical bonds in investigated samples [1]. This method is using to measure the photoabsorption cross-section for the excitation of primarily bound core electrons that makes NEXAFS spectra element specific since each atom has characteristic binding energies of core levels. Thus, we have a great opportunity to apply this method to obtain information about individual units and substitutional groups, and to explore their fingerprinting character using the building block concept. Moreover, the application of specific methods of spectra measuring and processing give the opportunity to determinate quantitative data from X-ray absorption cross section spectra expressed in oscillator strengths distribution. Our preliminary studies provide strong evidence that NEXAFS spectroscopy at the 1s-edge of C and N atoms is the most suitable method to examine structural changes and differences of organic and inorganic functional groups within biomaterials [2-5].

Investigated in current work cellulose and chitin are the most abundant biopolymers on the earth: first is the main constituent of plants, serving to maintain their structure, and is also present in bacteria, fungi, algae and even in invertebrate animals, second is known to occur as a component of the cell wall in fungi and diatoms, and is also found in diverse skeletal structures of at least 19 animal phyla. Chitin as a rigid scaffold is well-known in arthropod's cuticles as well in skeletons of marine and fresh water sponges [4,5]. The monomers of cellulose and chitin are β -glucose and N-Acetyl-D-glucosamine (NAG), respectively.

The main aim of the current work is to carry out for the first time experimental determination of fundamental parameters: absolute X-ray absorption cross section and oscillator strength distribution in the NEXAFS C1s-spectra of the selected biopolymers: chitin and cellulose with using of specific method for suppression and estimation of background radiation in incident synchrotron beam and measured TEY-signal. This problem solution is requires the specific multi-stage spectra processing and accuracy in measurements. All NEXAFS C 1s-absorption spectra were collected by total electron yield (TEY) mode with using synchrotron radiation of Russian-German beamline at BESSY-II. Absolute energy calibration of NEXAFS C1s -spectra was obtained by strong peak at 284,50eV in C1s-spectrum of C₆₀. All spectra were normalized to the incident photon flux determined by a clean Au-plate.

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