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XPS characterization of functionalized materials for photo-voltaic industry

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The modification of the electronic structure in semiconducting materials is the most actual task for the photo-voltaic Power Industry, because none of the undoped semiconductors is directly suitable to be the prototype of the photo-voltaic functionalized material [1]. The requirements for the "ideal" photo-catalyst allow to consider ZnO-Me (Me = Fe, Co, Mn) as a perspective, because the partial isovalent substitution of Zn-atoms in ZnO-host with 3*d*-metal atoms will results in E_g effective value reduction due to electron exchange-interaction [2]. This can be achieved using the pulsed ion-beam implantation (mono- and dual-type-ion) as a versatile tool for atomic structure engineering [3].

The electronic structure re-arrangement of the ZnO:Me (Me = Fe, Co, Mn) were found due to XPS characterization, which results in the appearance of the mid-gap-states in the valence band with the most dramatic VB structure transformations for dual-implanted ZnO:[Co-Mn]. As for the single ion-implanted ZnO-host, the ZnO:Fe system can be potentially assumed as promising photovoltaic substrate because, as it was established, Fe-doping also strongly reduces the band gap, and in this regime, the high level of doping used in the samples herein is appropriate.

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Nanosystem based on phospholipids and surfactants as innovative delivery system for gene therapy- circular dichroism and Fourier transform infrared spectroscopy studies

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The medical applications of gene therapy started in the end of XX century and now it's one of the most promising methods for treating a wide range of genetic diseases as well as neurodegenerative disorders or cancer. The main idea of this method is exchanging the defective gene with its proper copy or to block biosynthesis of improper proteins. Corrected genes are introduced to cells by special vectors (delivery systems). Perfectly suitable for this purpose are non-viral vectors - delivery system based on lipid/surfactant mixtures [1].

The aim of this study was to determinate the possible use of amphoteric surfactants (zwitterionic akyl derivates of sulfobetaine [2]) as agents forming complexes with nucleic acids. These complexes have potential applications for gene delivery [3].

A series of measurement of DNA conformation of DNA/zwitterionic surfactant lipoplexes were performed using the circular dichroism (CD) spectroscopy. CD spectra were recorded in the range 350 – 200 nm using J - 815 spectrometr (Jasco). The CD spectrum of pure DNA solution exhibits a positive band with maximum near 277 nm, the negative band with minimum near 245 nm and cross point near 260 nm. These parameters clearly indicate the B-DNA form (fully-hydrated). The increased surfactant concentration slightly shifts the bands towards higher wavelength.

Fourier transform infrared spectroscopy (FTIR) was used to analyse the structure and organization of lipoplexes. FTIR spectra of lipoplexes were collected using BRUKER Tensor 27 spectrometer (spectral range was 4000 - 400 cm^{-1} and temperature 275-313 K). The FTIR data proved the existence of stable lipoplexes.

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