Limanskii A.P. Modification and functionalization of probes and substrates for nanobiotechnology. – Manuscript.

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Experimental results are presented on the design and characterization of the modified and functionalized by biopolymers probes and substrates for atomic force microscopy (AFM) and results on the intramolecular compaction of single DNA molecules under influence of surface properties after their immobilization onto substrate. Amino mica (substrate for immobilization of biopolymers) with regulated hydrophobicity and surface charge density and amino modified and functionalized by biopolymers (DNA, bovine serum albumine) AFM probes were obtained and characterized by force measurements mode of AFM. Based on the AFM images obtained, DNA is proved to be a molecular spring that can be stretched and compressed as well. Stretched phage λ linear DNAs and pGEMEX supercoiled DNAs (which were characterized by helical rise per base pair ranged from 4,87 to 5,36 Å), as well as single molecules with an extremely high compaction level (i.e. molecules with a significantly higher superhelix density compared to those previously observed experimentally and estimated theoretically) have been visualized. The distance between nucleotides along the duplex axis for these supercoiled DNA molecules was varied from 1,94 to 2,19 Å. These compressed supercoiled DNA molecules are considered to be a new form of DNA, S-DNA. It was determined that DNA molecules are compacting into spheroids by three stages of subsequent folding in half with decreasing a length of superhelix axis, i.e. by the formation of superhelix axis of second and third orders.

Keywords: supercoiled DNA, atomic force microscopy (AFM), amino mica, S-DNA, oversupercoiling, DNA compaction, DNA adsorption, spheroid, toroid, force measurements, probe functionalization, cruciform structure.