The thesis describes time dependent fluorescence shift method and fluorescence correlation spectroscopy method (FCS) with its extensions FLCS, Z-scan FCS and dual-focus FCS applied on specific problems in DNA and lipid research. Compaction mechanism of a DNA molecule smaller than a resolution of a confocal microscope was elucidated. The process was revealed to be "all or non" for a polycation spermine as a condenser in contrast with the gradual compaction caused by a cationic surfactant. Biophysical properties of a phospholipid bilayer influenced by presence of oxidized phospholipids with truncated *sn*-2 chain were explored. The dynamics of hydrated functional groups in the headgroup region was proved to get faster while the hydration of the headgroup region increased. These effects are in relation with the reorientation of the short *sn*-2 chains observed in molecular dynamics simulations. Presence of oxidized species may also influence the lateral diffusion of the lipids – a slight increase of the diffusion coefficient was observed. Decrease of hydration and mobility in the headgroup region was found as an influence of heavy water on the phospholipid membrane. These finding are in line with molecular dynamics simulations which show longer lifetimes of hydrogen bonds between water and lipid molecules in presence of heavy water.