# CPL and RROA probes in the study of protein structure - induction of chirality and new methods of amplifying the chiroptical signal

Protein structural alterations play a key role in many neurodegenerative and civilization diseases, including Alzheimer, Parkinson disease, atherosclerosis, diabetes and other diseases that are related to the endothelium dysfunction. Typical protein structural changes upon disease state is the chemical modifications (phosphorylation, methylation, oxidation, peroxidation etc.), mutation of the primary structure, modification of the secondary structure (α-helix, β-sheet, etc.), as well as aggregation into fibril form. Spectroscopic methods sensitive to the chiral samples, have been recently proved to be very sensitive to the three dimensional structure, and structure alterations of the chiral biological systems, including proteins, and their aggregates, showing additional structural information, not reachable by any other method. However due to its nature, those methods usually hamper from the low intensity of the obtained signal, thus they were unsuitable for study of biomolecules in their natural, low concentrated, environment. As it recently turns, some of that methods, ROA (Raman Optical Activity) and VCD (Vibrational Circular Dichroism) can be enhanced due to the aggregation increasing of their sensitivity. Furthermore, another spectroscopic method: CPL (circularly polarized luminescence), and CPL based signaling probes, could also increase not only the intensity of the signal, but also sensitivity to structural changes.

The main scientific goal of the project is the spectroscopic screening of the structural modification of the amino acids, peptides and proteins in the model and biological systems, upon the influence of various physical-chemical conditions, as well as study of the intermolecular interaction of signaling probes with protein based, molecular and aggregated systems. The first task of the project is the study of model, protein based systems in the monomeric, native form and in the alternated form (e.g. aggregated form) that mimicking biological systems, by means of various spectroscopic methods, including Raman spectroscopy (RS), infrared spectroscopy (IR), UV-Vis spectroscopy, Raman optical activity (ROA), vibrational circular dichroism (VCD) and electronic circular dichroism (ECD). The second aim is to study the interaction of CPL (circularly polarized luminescence) and RROA (resonance ROA) probes with protein based systems, and preparation of spectral database of CPL/RROA spectra of different protein systems, including native, monomeric structures, as well as in the aggregated, fibril form. The third task is to study natural biological systems, primarily blood serum from different mice disease models, and study a potential of spectroscopic differentiation of healthy and disease mice model samples by CPL/RROA probing. To clarify additional structural information from spectroscopic measurements, the theoretical calculations of the spectroscopic properties of various molecular and supramolecular models will be also performed.