Ph.D. projects in progress

1.

Mentor: András Dér, Sándor Valkai

Doctoral School: University of Szeged, Doctoral School of Theoretical Medicine, University of Szeged, Doctoral School of Multidisciplinary Medicine

Ph.D. student: Dániel Petrovszki

Title of the research topic: Developing integrated optical structures with special respect to applications in medical diagnostics

Description of the research topic: Integrated optics is a new, rapidly developing discipline on the frontiers of engineering optics and lab-on-a-chip technology. Similarly to its electronic counterpart, its main goal is the formation of miniature optical structures on a small substrate surface. The widespread applications of integrated optics span from information technology to sensorics. The topic of the present call focuses on the development of label-free biosensors that allow rapid and specific detection of biomarkers or pathogenes, using simple optical working principles (e.g., interference or light scattering). The specificity of the sensor is achieved by proper functionalization of the optical sensor surface that, together with portability due to the small size and the simple working principle, envisages various point-of-care applications. The applicant is expected to design and prepare novel sensors, and optimize their sensitivity. A successful research work assumes a complex, multidisciplinary background of the applicant, while solving the arising technical problems requires a high-degree creativity.

2.

Mentor: András Dér

Doctoral School: University of Szeged, Doctoral School of Theoretical Medicine, University of Szeged, Doctoral School of Multidisciplinary Medicine

Ph.D. student: András Kincses

Title of the research topic: Lab-on-a-chip tool for the investigation of biological barriers

Description of the research topic: The investigation of fundamental biophysical processes (e.g. active and passive transport mechanisms) is key to understand the functions of biological barriers. The integrated biochips could play an important role to monitor the crucial physical parameters of the cell-culture based barrier models. The

aim of the research is the development of a versatile lab-on-a-chip device that can monitor barrier integrity, can be used for various kinds of barrier models, and can mimic the blood flow.

3.

Mentor: András Dér

Doctoral School: University of Szeged, Doctoral School of Theoretical Medicine, University of Szeged, Doctoral School of Multidisciplinary Medicine

Ph.D. student: Szilvia Krekic

Titleof the research topic: Photonic applications of proteins

Description of the research topic: Materials of biological origin - amongst others, mainly proteins - have extensively been ivestigated for possible utilization in optoelectronic applications. E.g., the invention about the application of the membrane protein bacteriorhodopsin in an ultrafast integrated optical switch has recently been registered in the USA Patent Office. Presently, we are working on exploring novel opportunities for applications utilizing other materials of biological origin, so far untested for this purpose.

4.

Mentor: András Dér, Ferenc Bogár

Doctoral School: University of Szeged, Faculty of Science and Informatics, Doctoral School of Physics

Ph.D. student: Zoltán Násztor

Title of the research topic: Investigation of the Hofmeister effect with simulation methods

Description of the research topic: Choosing the tc5b miniprotein as a model system, Hofmeister effect -related classical molecular dynamics simulations are carried out. In order to describe the relevant microscopic phenomena, the physical properties of the inetrfacial region are investigated. Besides establishing the spatial disctribution of ions, mapping of the protein-ion interactions are also used to characterize protein-related Hofmeister phenomena.

5.

Mentor: András Dér

Doctoral School: University of Szeged, Faculty of Science and Informatics, Doctoral School of Physics

Ph.D. student: János Horváth

Title of the research topic: Theoretical and experimental studies of the structure of water int he presence of spatial constraints and cosolutes

Description of the research topic: We have recently succeeded in elaborating a theory revealing connection between the structural stability of proteins and the protein-water interfacial tension. Among our further goals, we would like to shed light on the role of interfacial water in the interaction of macromolecules. To give an atomic-level interpretation of the phenomena, we are going to elaborate molecular dynamics simulation techniques, to support experimental findings.