Pulmonary diseases constitute one of the major health issues worldwide. Among them chronic obstructive pulmonary disease (COPD) is a significant cause of morbidity and mortality. It is usually associated with a prolonged exposure to the air pollution and toxic substances from cigarette smoke. According to the WHO data, 64 million people have COPD and 3 million people die of COPD each year. Currently ranking as the fourth leading cause of death behind cardiovascular disease, cancer, and stroke, chronic obstructive pulmonary disease is expected to be the third leading cause of death in 2030. Almost 90% of COPD deaths occur in low- and middle-income countries, where effective strategies for prevention and control are not always implemented or accessible. COPD is a condition involving largely irreversible obstruction of the airways and it is often characterized by alveolar wall destruction followed by the compression of airways during inspiration due to the loss of elasticity. The symptoms of COPD include frequent coughing and shortness of breath and are connected with the changes in the composition and properties of the lung surfactant lining the airways and pulmonary alveoli. It is a thin film composed of phospholipids, which is responsible for decreasing the surface tension during compression and preventing alveoli from collapse during ventilation.

Despite numerous studies concerning the medical implications of the changes in lung surfactant composition, the detailed physicochemical description of the properties of the lung surfactant in the chronic obstructive pulmonary disease is still missing. It is also not clear how these structural and compositional changes affect the efficiency of the COPD therapy with commonly used medicaments such as anticholinergics or other potentially effective drugs employed in the therapy, e.g. statins. Therefore, the main objectives of the project include characterization and comparison of the physicochemical properties of model lung surfactant layers typical for healthy people and chronic obstructive pulmonary disease patients. In the next step, the influence of the changes in the properties of lung surfactants on the effectivity of breathing process will be assessed. Additionally, the mechanisms of interaction of typical (e.g. anticholinergics) and other potentially effective drugs (e.g. selected statins) with the model lung surfactant will be explained. We will also verify the possibility of application of drug delivery systems for inhalation in order to increase the efficiency of the therapy. The model systems will be characterized by a variety of combined, highly-specialized surface sensitive techniques including microscopy, spectroscopy and neutron and synchrotron-based methods. Such a unique combination of the experimental approaches, which has not been employed so far in the studies of lung surfactants and their interactions with drugs, will provide a very detailed, molecular-level description of the biophysical properties of lung surfactants of different composition typical for COPD. Moreover, it will allow us to explain the mechanisms of interactions of inhaled drugs with such systems. This type of information is crucial for increasing the efficiency of the treatment as well as for the introduction of novel drugs for relieving COPD symptoms.