Interstitial lung diseases (ILD) refer to a broad category of noncancerous and noninfectious lung disorders involving interstitium - the space between the epithelial and endothelial basement membranes. Normal lung architecture and functions of cells are strongly altered by extensive deposition of collagen and other components of the extracellular matrix, leading to shortness of breath and ultimately, respiratory failure. ILD become remarkable problem especially for rich, eldering societies, as the incidence of the illness increase significantly with the patient age – from few to almost 200 cases per 100 000 for patients between 35 – 44 and more than 75 years old, respectively. In numerous ILD cases, the lung impairment is accompanied by fibrosis, which can state the illness itself, like in idiopathic pulmonary fibrosis (IPF). Although the etiology of the illness remain poorly defined, it is believed to be the result of an aberrant wound healing process in the pulmonary interstitium with minimal associated inflammation. The key problem, restricting strongly the therapeutical possibilities is the lack of precise diagnostic method, enabling unambiguous identification of one specific entity out of almost 200 possible interstitial lung diseases. Nowadays the diagnostic process is based on a multidisciplinary approach involving a pulmonologist, radiologist and pathologist expert and sophisticated examination techniques, such as high-resolution computed tomography (HRCT) or biopsy which makes it long, expensive and, unfortunately, still not always reliable.

One of the most important distinction would be the one between IPF and nonspecific interstitial pneumonia (NSIP). Although those two entities mimic strongly each other, the IPF is associated with the much worse hazard ratio for long-term mortality - median survival of patients with IPF is only 3 to 5 years after diagnosis. As the assurance of as early as possible IPF diagnosis have important implications on patient outcome and choice of treatment, one of the most extensively explored subjects is the search for new diagnostic tool, that would improve the diagnostic process and enhance the IPF prognosis.

The progress of IPF might be associated with an aberrant wound healing process in the pulmonary interstitium, due to fibroblast proliferation and abnormal accumulation of extracellular matrix (ECM) molecules. Moreover, the increased matrix stiffening observed in the lung fibrotic process may be a critical fibrogenesis driving factor and the myofibroblast differentiation can be induced in fibroblasts merely by altering the stiffness of the underlying substrate. Therefore the substrate elasticity becomes extremely important factor, which influence on cellular behavior needs detailed examination to enable deeper understanding of IPF and NSIP lung impairment. As the cytoskelet organization as well as contractility of fibroblast originating from IPF and NSIC differ, also their mechanical properties should be different. This implies altered interactions of both cell lines with substrate with given elasticity, which could be promising ‘marker’ enabling unambiguous differentiation between both entities and progress towards understanding the nature of different course of both disorders.

The main goal of the presented project is a performance of comparative analysis of physico-chemical properties of originating from two distinct ILD diseases - IPF and and NSIP cultured on two- and three-dimensional elastomer (PDMS) substrates with tuned mechanical and chemical properties. Such complex analysis, especially performed on 3D substrates imitating porous lung tissue will enable deeper understanding of environmental factors and mechanisms favoring fibrotic process and will contribute to recognition of its etiology. Subsequently a set of parameters enabling unambiguous distinction of fibroblasts originating from IPF and NSIP will be defined, which can be used as a basis for effective label-free identification of cells, delivering powerful tool for early stage diagnosis and personalized therapy.