Molecular transporters, chemical species which can act as carriers for other, smaller molecules or ions, are particularly interesting, or even fascinating objects of many studies. They can be responsible for delivering specific chemical compounds to precisely defined sites, e.g. in human organism, they protect the compounds embedded in them from harmful environmental influence, and they are able to modify the release rate of the incorporated chemicals. Among numerous possible applications of molecular transporters are therapeutic systems, which can be used as drug carriers and deliverers, molecular containers for energy storage, and systems used for gases separation and/or purification.

However, if the known molecular transporters are to be applied in the mentioned areas, and the new ones, with desired features, are to be designed, a deeper understanding of the mechanisms, which decide on their properties and functions is needed. This issue is tackled in the current project. The planned research involves silica-based systems with pores present in their structure, inside which a drug molecule can be incorporated. We will also be dealing with self-assembly processes of peptides, and the analysis of nano- and microtubes, which will be formed in the result of these processes. We will investigate porous peptides, applicable as gases separation systems, as well as chemically modified porhyrin-peptide systems, potential theranostic agents to be used as ion carriers. We will describe structural features, which decide on the propensity of particular systems (or on the lack of this propensity) to self-assemble, we will indicate which intermolecular interactions make an effective carrier for selected chemical compounds, and finally we will determine which structural aspects and in what way influence the release rate of the substances embedded inside the carriers. As a result, not only our knowledge on molecular transporters will become deeper, but also new carriers systems, with significant applicability (*e.g.* in pharmaceutical industry) will be created.

The main analytical technique, which will be used in our project, is solid-state NMR spectroscopy. The method allows for detailed analysis of both structure and dynamics of the studied systems, without a necessity of dissolving them in any solvent. It also facilitate a precise description of subtle intermolecular contacts, which often decide on the specificity of the interactions in host-guest systems, and indicate possibilities of future applications.