Silsesquioxanes belong to a class of organosilicon compounds possessing well-defined, regular, three-dimensional nanostructure and unique hybrid properties (Figure 1). Since their discovery, silsesquioxanes have been the subject of much interest due to their versatile features, such as excellent physical, mechanical, optic and electrical properties as well as high thermal and photochemical stability. In recent years, these compounds have been widely applied in various fields of material chemistry, cosmetic industry, medicine, catalysis and electronics.

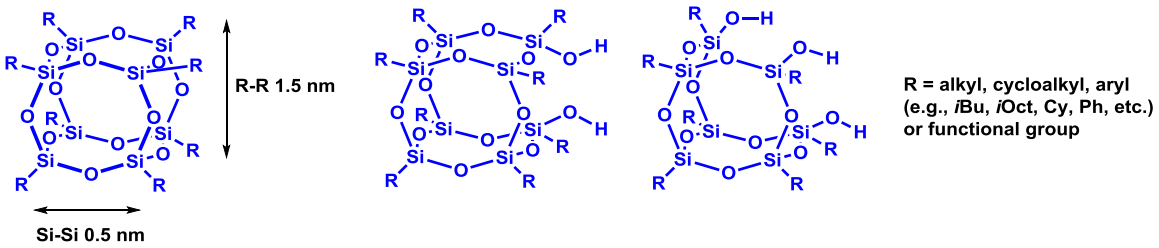

Figure 1.The structure of completely and incompletely condensed silsesquioxanes.

The problem is that conventional methods for the synthesis and modification of silsesquioxanes are mainly based on the hydrolysis and condensation of halogenosilanes or alkoxysilanes. These methodologies involve the use of moisture-sensitive reagents, therefore suffer from the lack of chemoselectivity and functional-group tolerance. What is more, these reactions proceed with the formation of harmful and reactive by-products (e.g., HCl), which are difficult to remove. Taking this into account, the catalytic approach to silsesquioxane derivatives is of high relevance.

The scientific purpose of the proposed project is to develop novel, effective and selective catalytic methods for the synthesis and modification of silsesquioxanes, using commercially available and non-toxic organosilicon reagents. Contrary to the traditional approach, the main aim of this research is to find efficient and convenient synthetic routes to functionalized silsesquioxanes, proceeding under mild conditions with the formation of no harmful by-products, which are difficult to remove. This proposed catalytic strategy will enable synthesis of a wide range of functionalized silsesquioxanes, which are important building blocks in material chemistry. Within this project, it is also planned to use the obtained silsesquioxanes containing reactive functional groups as reagents for further functionalization.

The novel silsesquioxane derivatives, synthesized during the research, may have the potential for wide commercial applications, e.g., as precursors of new functional hybrid materials possessing regular nanostructure and unique properties. These compounds may be used in various areas of materials science, catalysis and nanotechnology.