Layered clay minerals are very interesting raw materials for preparation of modern, advance catalysts and catalytic supports. It is related mainly to a broad range of various methods of their modifications resulting in conversion of these relatively cheap minerals to high surface area materials with the homogenous porous structure, acid sites and ion-exchange properties. These methods are based mainly on deposition of inorganic pillars into the interlayer space of clay mineral. Methodology of layered clay minerals intercalation by inorganic oligocations deposition into their interlayer space or pillaring with silica aggregates by surfactant directed method was successfully developed in last decades. Depending on the intercalation method, type of pillaring agent as well as type of clay mineral used, the high surface area materials with the designed porous structure can be produced. Moreover, pillared clays exhibit relatively high thermal and hydrothermal stability, surface acidity as well as ion-exchange properties that allow to deposit catalytically active cationic species in the controlled way. Thus, pillared clays are very promising materials for potential applications in catalysis.

Nearly two decades ago, new type of synthetic layered zeolites was developed. The methodology of synthesis of such 2D-zeolites, with designed Si/Al ratio and microporous structure, was successfully elaborated. Such layered zeolites can be intercalated by surfactant directed method with silica pillars or delaminated producing materials with the hierarchical pore structure. Pillared zeolites are believed to improve the catalytic efficiency in conversion of bulky molecules (e.g. synthesis of ethers), where internal diffusion processes may control the overall process rate.

Inspiration of intercalation of 2D zeolites was earlier studies of layered clay minerals pillarization. Although, in the beginning, intercalation of zeolites was based on experience gathered for pillaring of clay layered minerals, in the next years developments related to intercalation and delamination of both these groups of layered materials were nearly independent. Therefore, in the frame of the proposed project the studies focused on adaptation of the methods developed for pillarization and delamination of layered zeolites for modification of clay minerals and vice versa will be conducted.

Layered zeolites will be synthesized and intercalated with inorganic pillars mono- (SiO_2, TiO_2, ZrO_2, Al_2O_3) and multicomponent (e.g. SiO_2-TiO_2, SiO_2-Al_2O_3) by surfactant directed method as well as ion-exchange and template exchange methods. Porous structure will be controlled by selection of suitable 2D-zeolite, pillaring method and pillaring agent. Surface acidity nature, density and strength of acid sites) and ion-exchange properties will be adjusted by the synthesis of zeolite with the proper Si/Al ratio and pillaring agent. Size of interlayer pores will be adjusted using different types of surfactants, different surfactant/silica source ratios and various raw clay minerals (with various density of layer charge). Moreover, layered clays will be delaminated according to the procedures developed for layered zeolites. Various method of transition metals deposition resulting in their different forms and aggregation, will be used. The obtained materials with designed porous structure and controlled surface acidity will be tested in laboratory scale as catalysts for the selected processes: ethers synthesis, ethanol to ethylene conversion and $DeNO_x$).

Successful realization of the project will be possible only by contribution of scientists from Jagiellonian University in Kraków (JU) supported by specialists form University of Science and Technology (AGH) experienced in functionalization of clay minerals, including their pillaring processes, for catalysis and adsorption. Moreover, in the frame of the proposed project cooperation with Instituto de Tecnología Química (ITQ) in Valencia is planned. ITQ is a world leader in the field of synthesis, intercalation and delamination of layered zeolites. Thus, cooperation between these partners guarantees the successful achievement of all objectives of the project.

Proposed project should result in development of methodologies for synthesis of advanced hybrid materials with the controlled hierarchical porous structure and catalytic properties tailored for the selected processes.