Mercury is an element that stands out from the others in the periodic table. It has a number of physicochemical properties that cause significant difficulties in fully understanding the interaction of this element with the surrounding environment. From the point of view of the energy industry based on fossil fuels combustion processes, a special case is the interaction between elemental mercury (Hg^0) that occurs in exhaust gases and minerals/synthetic materials possessing sorbent properties. This project concerns investigation of natural, spatial aliminosilicate minerals from Heulandite and Faujasite group, their modified and synthesized-modified analogues behaviour relative to Hg^0 removal from inert gas carrier stream (Argon). The following project objectives are proposed:

- Indication of the physicochemical properties of natural and modified structures - factors that increase affinity to bond and removal of Hg^0 from gas stream.
- Study and indication of the mechanisms responsible for Hg^0 bonding in mineral structures.
- Modification of minerals in order to increase their affinity to Hg^0.
- Synthesis and modification of analogue (to natural) structures in order to compare their Hg^0 removal effectiveness.
- Study of undesirable desorption phenomenon - unwanted release of sorbed mercury.

Proposed project is divided into several stages which will ensure objectives execution:

I. Development of prototype device SBPR-1 designed for testing solid sorbents ability to remove Hg^0 from the carrier gas. The modification involve expanding the device operation with the possibility of testing desorption.

II. Modification of selected aluminosilicate minerals in order to increase their affinity to bond Hg^0. Physicochemical modification will be performed by minerals disintegration and testing same mass of sorbent represented by several fractions. Given fractions will be surface-nebulized by ionic solutions. Chemical modification will be implemented by introducing range of metal ions into active centres of sorbent structures. It will be performed using ion exchange method.

III.. Innovative simultaneous synthesis-activation of the naturals phases analogues, optimization of synthesis parameters. Hydrothermal syntheses under changing conditions of: time, temperature, NaOH concentration, solution/solid state ratio. Seed crystals addition will be performed in order to increase the synthesis yield.

IV. Physicochemical characterization of spatial alimunosilicates from Heulandite and Faujasite group, , including investigation of the unit cell parameters evolution and sorbents resistance to aging process. Products will be studied using modern methods of instrumental analysis such as: Scanning Electron Microscopy, X-Ray Diffraction and Fluorescence, and Atomic Force Microscopy for the study of nucleation process**.** Testing of minerals and their synthesized/modified analogous on SBPR-1. Mechanisms of Hg^0 interactions with sorbents will be studied using FTIR method.

- Testing of minerals/analogues with various mass in sorbent bed (from 0.0125g to 0.1g) in order to investigate if a change in sample mass (in a linear way) will give a non-linear relationship with Hg^0 concentration.
- Dividing the main sorbent bed into 2 or 3 smaller ones separated by neutral material in order to investigate if such action will have a positive effect on the amount Hg^0 removed.
- Testing the impact of sorbent moisture and zeolitic water content to Hg^0 removal efficiency.
- Testing of minerals/analogues mixtures in order to study the best percentage coordination of given minerals that will show higher mercury removal capacity than beds composed of monomineral sorbent.
- Investigation of the Hg^0 desorption phenomenon, to ensure if the used sorbent is safe.

The results of this project may significantly expand knowledge on the physicochemical, crystallochemical features of natural, spatial aluminosilicate structures as well as their synthetic analogues. Particularly emphasized will be the subject of interactions of crystal structure active sites with Hg^0 as well as changes taking place at the unit cell level, mechanisms governing nucleation and crystallization processes. Results will allow to learn the mechanisms of Hg^0 bonding, which are still difficult to study, because Hg^0 in contact with various ions present in sorbents may be oxidized and thus nature of sorption is changing. Knowledge about sorption mechanisms is crucial for the proper and effective modification of zeolites and their adaptation for Hg^0 removal. The innovative nature of the research will be ensured through several issues:

- Using unconventional, innovative and prototype installation SBPR-1.
- Deep insight into interactions and mechanisms between Hg^0 and spatial aluminosilicates from Heulandite and Faujasite group: natural/natural-activated/synthesized-activated zeolites.
- A deep insight into nucleation processes as well as mechanisms governing the evolution of a unit cell.

In the future obtained results may be the foundation for attempts to produce new, effective mercury sorbents and contribute to environmental protection (in particular in the energy industry based on coal combustion processes).