Quasicrystals were discovered in 1984 by Dan Shechtman (Nobel Prize in 2011). Due to the unique atomic structure quasicrystals are hard and brittle, have low thermal and electrical conductivity, low surface energy and good wear resistance. These unique properties of quasicrystals suggest that they can be used as antiadhesive and protective coatings or as a reinforcement in metal matrix composites prepared by powder metallurgy technology.

The biggest potential practical applications are stable quasicrystals from the Al-Cu-Fe system due to non-toxic, easy available and cheap alloying elements and the possibility of recycling. Al-Cu-Fe quasicrystals have icosahedral structure and they can be obtained only a narrow range of composition: 20-28% at. Cu and 10-14% at. Fe. Receiving quasicrystals by conventional casting method is very difficult that's why unconventional methods of obtaining are used; such as rapid crystallization (melt spinning, spray deposition, gas atomization) or mechanical alloying that extend the presence of quasicrystalline phase.

Mechanical alloying is method of preparation of alloys by cold welding. In the process powders of pure elements or alloys are intensively milled in a ball mill. This method allows the synthesis of the alloy at room temperature and also gives possibility to obtain alloys from the elements with large differences in melting temperatures.

Another way to expand the area of quasicrystals appearance is the addition of alloying elements. So far, the effect of the wide variety of elements (Ti, V, Cr, Mn, Co, Ni, Si, Ge, Zr, Nb) for the presence of quasicrystalline phase in Al-Cu-Fe system. It was found that some additives have a positive influence on the formation of quasicrystals and sometimes alter the structure from the icosahedral into decagonal. This has a significant effect on the properties of the material; strength, hardness, thermal and electrical conductivity and surface energy. The influence of alloying elements during the formation of quasicrystalline phase during mechanical alloying method has been tested on a small scale. In literature are described only few papers about effect of the addition of Si to the formation of quasicrystals and it was found that the silicon is built into the atomic structure and stabilize icosahedral-like phase in high temperature.

The innovative nature of the research is to investigate the effect of additives of selected elements p- and d- blocks on the formation of quasicrystalline phase in the Al-Cu-Fe system during mechanical alloying. The project presupposes to produce a variety of alloys based on a ternary Al-Cu-Fe system using a mechanical alloying method. Due to the few reports in the literature regarding the use of alloying elements in the Al-Cu-Fe system obtained by the above method, during the project new elements as alloying additions will be examined.

The main objective of the project is to produce and investigate the effect of alloying elements with p- and d- blocks on the formation of a stable quasicrystalline phase in the ternary Al-Cu-Fe system using mechanical alloying, and to examine their impact on the stability in high temperature. Quasicrystals produced in this system are cheap, non-toxic and can be used as a recyclable reinforcement for metal matrix composites (MMC). They are wide group of advanced construction materials used in the space industry, aerospace or automotive.