Zirconium is an interesting engineering material because of its high melting point (about 1860° C). Zirconium is high chemical resistance, it has good machining characteristics and welding behaviour and is completely recyclable.

Zirconium alloys have been widely used as nuclear fuel cladding tubes and structural materials due to low neutron absorption cross-section, superior corrosion resistance and high mechanical strength. However, its use in the manufacture of machine parts or other types of parts by the normal casting and machining methods is impractical and difficult. Furthermore, since high purity zirconium metal is very expensive, machining losses are prohibitive. For this reason powder metallurgical techniques will be resorted to manufacture of zirconium parts. In accordance with these techniques parts can be manufactured by pressing and sintering at temperatures considerably below the melting point of the material and furthermore there is practically no material lost. Sintering methods are not used for the production of zirconium and its alloys due to insufficient material density after sintering. Zirconium presents a distinct problem, for, although it is possible to produce the zirconium parts using powder metallurgy methods, two major difficulties are encountered. One, finely divided zirconium is pyrophoric. Two, the metal, from which the powdered zirconium is obtained by comminution is so ductile as to make it relatively difficult to prepare fine particles of a suitably high bulk density. The use of pressure technique should increase the density of zirconium sinters.

It will be taken into consideration mainly pressure technics of sintering (Spark Plasma Sintering - SPS and High Pressure Spark Plasma Sintering – HP SPS) and the extrusion. The aim of the project will be to determine the influence of heating, cooling rates and duration of sintering on the synthesis reaction in binary Zr systems (Zr-Nb, Zr-Cu, Zr-Mn). In the studies the amount of the metals addition will be up to 2.8 wt.% (more for Zr-Cu alloys).Mixtures will be prepared using the mechanical alloying. The multistage densification mechanisms during SPS processes and extrusion method will be described. Zr-Cu alloys can be used as a medical material, Zr-Nb is chosen because of good mechanical properties, and Zr-Mn for use in the nuclear industry.