

The project is devoted to study the magnetocaloric effect (MCE) in the Heusler alloys. Magnetocaloric effect is the change of temperature of a ferromagnet under the influence of the magnetic field in terms of thermal insulation. MCE is of interest for magnetic cooling. Magnetic refrigeration technology can be used to create a new type of energy-saving, environmentally friendly solid-state magnetic refrigeration. In addition, MCE is a unique research tool in solid state physics.

In our case, the Heusler alloys will be used as ferromagnetic materials with different chemical composition. The Heusler alloys have unique physical properties. This is a giant MCE and magnetic shape memory, i.e. the ability of a material to change shape when the magnetic field turn on and return to its original state when the magnetic field turn off. This is due to the fact that in the Heusler alloys in contrast to conventional ferromagnetic materials while the magnetic phase transition changes the crystal structure of the sample. For this reason, in the Heusler alloys is implemented by two main mechanisms leading to the phenomenon of MCE. The first mechanism is associated with the alignment of the magnetic moments exerted by the magnetic field, which is disordered by thermal fluctuations. In parallel with the first mechanism in Heusler alloys implementing the second mechanism, contained to change the crystalline structure of matter under the influence of a magnetic field. In the Heusler alloys is implementing the second mechanism in parallel with the first mechanism, contained to change the crystalline structure of matter under the influence of a magnetic field. In terms of thermal insulation, these two mechanisms lead to a significant temperature change in Heusler alloys, which is called giant MCE. MCE is implemented for the first mechanism is fully reversible, i.e. the effect size is constant at given temperature and magnetic field and is independent of the number of on / off of the magnetic field. In turn the MCE is implemented for the second mechanism is partially irreversible. This makes difficult the use of such materials for magnetic cooling. For this reason, one of the main goals of the project is to study the irreversibility of MCE in the Heusler alloys. The results of the work plan is to develop a scientific theory, which will help to reduce the amount of irreversibility of the MCE.

The studied Heusler alloys are of interest in the promising technology of magnetic refrigeration. Magnetic refrigeration technology can be used to create a new type of energy-saving , environmentally friendly solid-state magnetic refrigeration . Estimates show that these refrigerators will be 30-40 % more efficient than the existing compressor refrigerators , which will save up to 5 % of total electricity consumed in the world. In addition, these refrigerators are environmentally friendly, as it does not use freons, which deplete the ozone layer.