

Abstract

The main area of this thesis is the research on magneto-, mechano- and multicaloric effects in Ni–Mn–In Heusler alloys, with the idea of using them in multicaloric refrigeration systems. There is wide research niche in the area of preparation of new caloric materials in quantities useful for prototyping of cooling systems. Vast majority of research papers focus either on purely materials engineering point of view, on the thermal engineering point of view. Very rarely there are research papers that describe both the manufacture of new materials and their application in caloric system.

The research began from the literature analysis – based on many research papers, the Ni–Mn–In Heusler alloys were chosen, because they have elasto-, baro- and magnetocaloric effects in single alloy. Next, various devices needed to manufacture and characterize the alloy samples were designed and built:

- The induction melting system was constructed, which allows to heat up to about 200 g of metal up to 1600 °C, and the metal can not only be melted in crucible, but there is also the possibility of zone melting, which allowed to manufacture long, homogenous rods of the alloys.
- Test stand for measuring the changes of magnetic permittivity with the change of temperature was designed and built, which allowed for quick characterization of samples in the terms of magnetostructural changes, which are key properties of Ni–Mn–In multicaloric alloys.
- Elasto- and magnetocaloric adiabatic effect test system was designed and built, which allowed for measurement of magneto-, elasto- and multicaloric (by application of two stimuli simultaneously) properties of synthesized alloys.
- Prototype of magnetocaloric cooling system was designed and built, and two different geometries of magnetocaloric regenerator was tested and compared.
- The multicaloric cooling system was designed, using the magneto- and elastocaloric effect synergy.

The results of measurements confirm that there is synergy between elasto- and magnetocaloric effect in the $Ni_{50}Mn_{35}In_{15}$ alloy.