Thermoelectric power in intermetallic compounds

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Short general introduction

Thermoelectric phenomena have been used for a long time in basic research for temperature measurements. Thermocouples of high efficiency are employed in cooling devices, air-conditioners, thermostats, and electric power generators.
The practical utility of thermoelectric materials is usually described via the figure of merit ZT, which depends not only on the value of thermopower but on the electrical and thermal conductivity as well.
Therefore, a design of new thermoelectric materials requires a better understanding of these phenomena and the basic research is important both for explanation of the fundamental mechanisms and for indication of new solutions for applications.

Research project objectives and methodologies

The main objective of the PhD thesis will be a study of the basic mechanisms, which influence the thermopower S, thermal conductivity λ, and electrical resistivity ρ in compounds and alloys, for which these phenomena are difficult for interpretation in frames of the standard models dedicated for metals.
The research will concern compounds based on anomalous lanthanides (Ce, Yb), where the hybridization effects influence strongly the scattering mechanisms and on intermetallic compounds showing various magnetic orderings, including spin-glasses.

Institute of Molecular Physics has one of the view laboratories equipped in apparatus enabling simultaneous measurements of S, λ, ρ in wide range of temperatures and magnetic fields, which allows for unique studies in the area of thermoelectric materials.

The compounds and alloys will be prepared by the inductive and/or arc melting and then investigated using the following equipment accessible in Institute of Molecular Physics:
- X-ray diffractometer: identification of the crystallographic structure
- two Quantum Design Physical Property Measurement Systems (PPMS), equipped in a unique set of experimental options: electrical resistivity measurements, magnetoresistance, Hall effect, thermopower, thermal conductivity, specific heat, magnetic susceptibility, magnetization. All options are accessible in wide range of temperatures and magnetic fields.