Development of $H$-$T$ phase diagrams in $U$-based intermetallics using ultrasound method

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Strong correlation between structural, magnetic, and electric properties makes studies of the elastic properties of solids an important direction of experimental condensed-matter physics. Studies of elastic properties provides information about lattice distortions, spontaneous and field-induced phase transitions, crystal-electric-field schemes, and multipole interactions. Data obtained from temperature and field dependencies of elastic moduli makes it possible to map out or to complement existing $H$-$T$ phase diagrams.

In MGML laboratory (open access research infrastructure, www.mgml.eu), ultrasound is a newly introduced technique, complementary to well-established thermal expansion and magnetostriction. One of the main research areas in the MGML is $U$-based intermetallics (which includes $\text{UIrSi}_3$, $\text{UAu}_2\text{Si}_2$, $\text{UCoGe}$, $\text{UIrGe}$, $\text{UTe}_2$ families). The laboratory has capabilities to grow high-quality single crystals, carry out measurements of a number of physical properties in magnetic fields up to 19.5 T and perform calculations. Modifications in acoustic mounting procedure and redesign of the sample holder are needed for the experiments with the $U$-based intermetallics. As an example $\text{UIrSi}_3$ elastic properties were recently studied in static magnetic fields up to 19.5 T [2]. Some pronounced spin-lattice effects were found and a theoretical model explaining them was proposed.

![UIrSi3 tetragonal structure and the polished single crystalline sample][1].

![UIrSi3 phase diagram complimented with acoustic data][2] (grey color existing diagram [1]).

The work will consist of the $U$-based single crystals orientation via Laue diffractometer and polishing plan-parallel sides along main crystalographic axis and planes. One would learn the mounting procedure of fragile submillimeter-size samples (transducers, bond, sample mounting, screening, etc.) as well as performing the ultrasound measurements using the pulse-echo technique (PPMS option). A number of experiments to be performed to measure field and temperature dependencies of relative change of sound velocity.

References:
