X-ray diffraction study of the magnetostructural phase transition in FeRh

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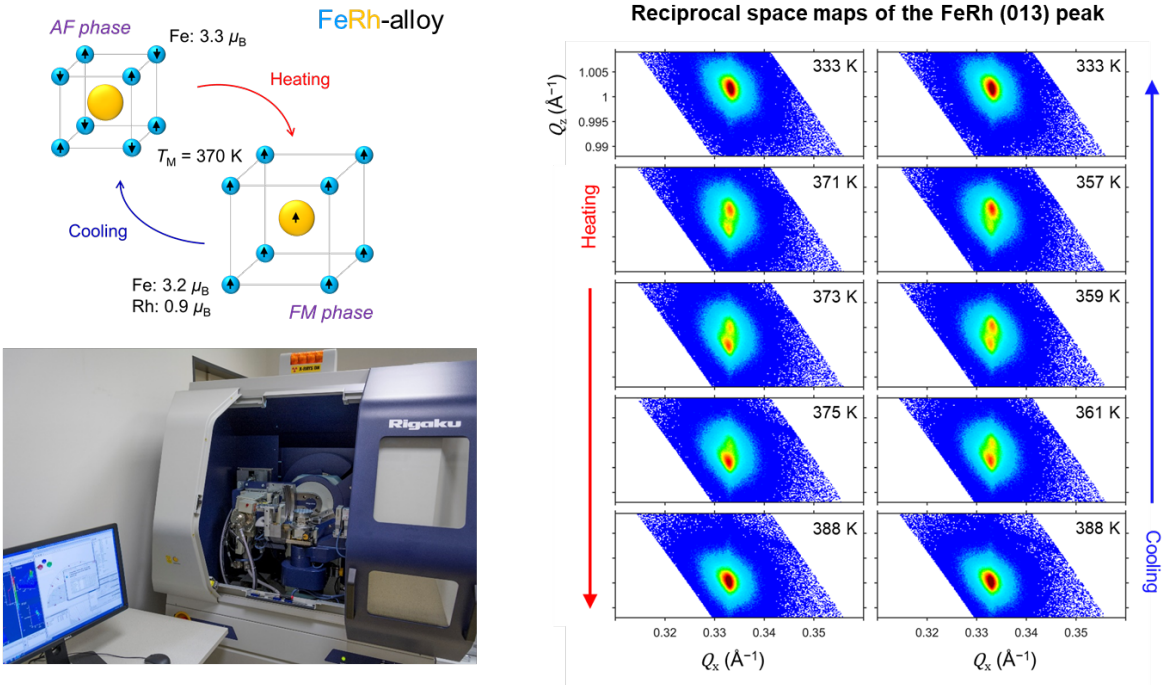
In this talk, I will briefly introduce the x-ray diffraction technique as a tool for structural characterization of thin films and nanostructures in condensed matter physics, while highlighting the capabilities of the diffractometers that are available at CEITEC Nano. In addition, I will present our work on x-ray diffraction characterization of the magnetostructural phase transition in epitaxial FeRh films. The equiatomic and chemically ordered FeRh alloy exhibits a first-order metamagnetic phase transition from antiferromagnetic to ferromagnetic order at an atypically high temperature of 370 K, which is just slightly above room temperature. Together with the modification of magnetic order, an increase of the lattice unit cell and a reduction in resistivity are associated with the transition, which features interconnected structural, electronic and magnetic order parameters. The rich variety of options one can exploit to drive the transition (temperature, magnetic field, pressure, electrical current, optical pulses) as well as the commensurate changes in magnetization, magnetoresistance and entropy make FeRh an interesting prototype material for technological applications. By means of our detailed x-ray diffraction studies, we are able to obtain fine structural details during the co-existence of both phases across the transition, such as the phase-specific strain state. This helps us to unveil details on the interplay of structural and magnetic degrees of freedom across the transition. For instance, we have recently found that the phase transition in FeRh can be highly asymmetric when comparing the nucleation kinetics during heating and cooling, observing a pronounced supercooling in the latter case. I will explain that such a behavior shares some similarities with the liquid-to-solid phase transition in water, which is also first-order in nature.

**In collaboration with Vojtěch Uhlíř, Ondřej Caha (CEITEC MU) and Eric E. Fullerton (UCSD)*



(Top left) Schematic of the magnetostructural transition in FeRh. (Bottom left) Rigaku x-ray diffractometer at CEITEC Nano. (Right) Temperature dependent reciprocal space maps of FeRh across the magnetostructural phase transition.