Transversal Magnetostriction in Uru_2si_2

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Introduction

Even though the 4*f* Ce-based compounds are by far the most extensively studied heavy fermions, it is a 5*f* uranium compound, namely, URu_2Si_2, which remains as one of the most intriguing and unsolved systems among the strongly correlated electron materials [1]. URu_2Si_2 becomes an unconventional superconductor at Tc = 1.2 K and, well above Tc, a clear second order (mean-field-like) transition occurs at T_{HO} = 17 K. Under a magnetic field, URu_2Si_2 exhibits a fascinating behavior. As usual, superconductivity is suppressed by just a few Tesla while about 35 T are needed to destroy the HO phase. The high-magnetic-field properties and their connection to the HO are still an ongoing study. In a recent work, Correa et al. reported high DC magnetic-field linear thermal-expansion and magnetostriction results on URu_2Si_2 single crystals, but little is known about the behavior of the crystal symmetry or even the crystallographic unit cell volume at high fields.

Experimental

We measured for the first time the magnetostriction $\Delta L \parallel H \parallel c$-axis and $\Delta L \perp H \parallel c$-axis of URu_2Si_2 single crystals in the NHMFL 60T motor generator-driven long pulse magnet at various temperatures between T = 1.3 K and 20K with the goal of determining the volumetric magnetostriction. We used an optical FBG technique running at 46kHz, with the 125μm optical fiber mounted parallel and perpendicular to the magnet axis.

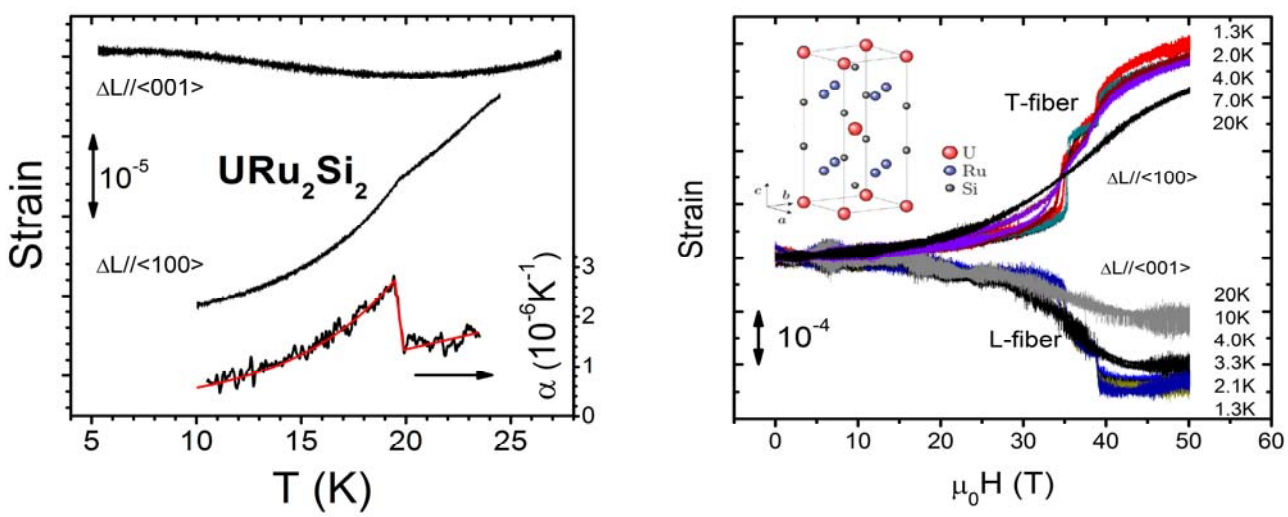

Fig. 1 Left: Zero field strain (ΔL/L) vs temperature, and coefficient of linear thermal expansion α(T) showing a clear anomaly at T_{HO} when ΔL//*a*-axis. **Right**: Strain ΔL/L vs magnetic field measured parallel and perpendicular to the applied magnetic field H//*c*-axis.

Results

We observe a coefficient of thermal linear expansion α(T) in zero applied field that is consistent with earlier measurements using capacitive dilatometers. These results show that the crystal unit cell shrinks upon entering the HO phase. On application of a strong magnetic field, the *c*-axis shrinks but the *a*-axis expands. Since the volume computation must factor in the *a*-axis twice in a tetragonal lattice we conclude that the unit cell volume expands upon suppression of the OH phase with external fields.

Acknowledgements

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References

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