Magnetic Meta-stability Measurement in $CeRu_2Ga_2B$

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Introduction

During the past several decades, strongly interacting electronic systems have been intensely investigated due to the rich variety of emergent phenomena that they exhibit. $CeRu_2Al_2B$ is one of such system, where localized 4f magnetic ordering is observed. For this compound, the application of a small magnetic field, *H,* produces an interesting *T-H* phase diagram [1]; this fact motivated us to explore the Ga-based structural analogue $CeRu_2Ga_2B$, which shows a ferromagnetic (FM) transition at a Curie temperature T_c = 15.4 K [2].

Experimental

A single crystal of $CeRu_2Ga_2B$ was produced by using the Czochralski technique [2]. Torque Magnetization M*(T,H)* measurements were performed over the temperature range *T*=1.7-24 K under different applied magnetic fields by means of a micro-cantilever technique. The micro-cantilever with the sample on it [see **Figure 1**] was placed in a single shot fridge in a ^{4}He variable temperature insert to control the temperature down to 1.7 K in a 15 T superconducting magnet.

Results and Discussion

Figure 2 shows the torque magnetization temperature dependence. The initial magnetic state was prepared by applying 0.03 T at *T* > *Tc* and cooling down. By subsequently increasing *T* (indicated by an arrow), *M* decreases to reach a local minimum at around 12.5 K, a fast change in the torque signal appears at *Tc* = 15.4 K in agreement with our previous report [2] and over this temperature no magnetic changes are detected. Upon cooling down again, the magnetic signal follows a different path, revealing hysteresis below *Tc.* These non-equivalent magnetic states depend on the magnetic history and repeat when temperature is cycled. This behavior suggests the formation of different magnetic structures which can be controlled by means of temperature and applied magnetic field.

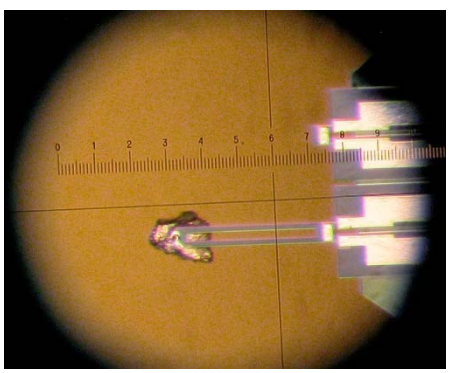

Figure 1. 1221Ga Sample on a 400 μm beam length.

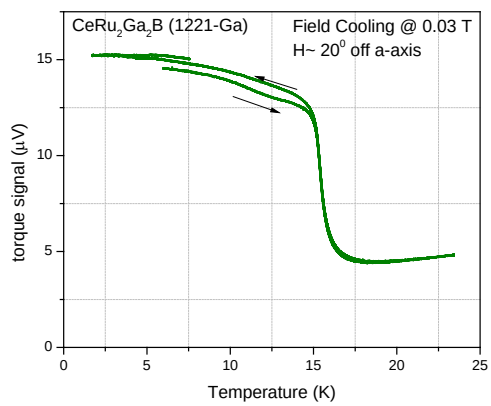

Figure 2. Torque signal as a function of temperature.

Conclusions

$CeRu_2Ga_2B$ and related compounds exhibit interesting magnetic phenomena. The hysteretic behavior in magnetization is intrinsic to the 1221-Ga compound and may originate from different magnetic structures that depend on the magnetic and thermal history. The possibility to control the magnetic structure in this relatively simple compound may impact future applications.

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References

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[2] Baumbach, R.E. *et al*. *J. Phys.:C Condens. Matter* **24**, 185702 (2012).