Measurement of Heat Capacity in Nanomaterials of Varying Size and Separation Down to Low Temperature

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Introduction

Nanoparticles have dimensions in the 1 to 100 nm range and possess properties that are size-dependent and often uniquely different from those exhibited by their bulk counterparts. Optical, electronic, and structural properties of materials, among other characteristics, are known to change in the "nano" regime. The possibilities of property-tuning and unique behavior are extremely attractive from the perspectives of technological applications and fundamental understanding of materials.

It has been suggested that the phonon density of states of nanoparticles is different from bulk materials. We proposed to measure the heat capacity of CeF_3 nanoparticles with different sizes down to low temperatures to investigate these differences.

Experimental

CeF_3 nanoparticles embedded in oleic acid were prepared by solution precipitation. The samples were characterized by x-ray diffraction (XRD) and transmission electron microscopy (TEM).

Heat capacity measurements were carried out using standard thermal relaxation techniques.

Results and Discussion

X-ray diffraction and transmission electron microscopy measurements confirmed the crystalline nature of the nanoparticles and determined their size to be about 12 nm. Heat capacity measurements showed a deviation from the T^3 behavior for temperatures below ~5K (Fig. 1).

Conclusions

A deviation from the T^3 behavior was observed at low temperatures. Further measurements are needed to provide a deeper understanding of this result.

Acknowledgements

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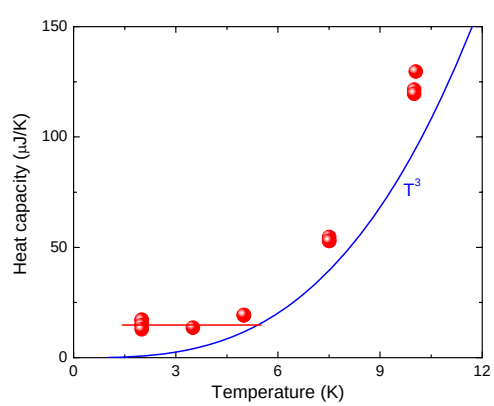

Fig. 1 - Partial heat capacity measurement results at low temperatures for CeF_3 nanoparticles.