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Phase diagram of $URu_{2-x}Fe_xSi_2$ in high magnetic fields

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Introduction

The search for the order parameter of the hidden order (HO) phase in URu_2Si_2 has attracted an enormous amount of attention for the past three decades [1]. Measurements in high magnetic fields H up to 45~T reveal that URu_2Si_2 displays behavior that is consistent with quantum criticality at a field near 35~T, where a cascade of novel quantum phases was found at and around the quantum critical point, suggesting the existence of competing order parameters [2]. Experiments at high pressure P reveal that a first order transition from the HO phase to a large moment antiferromagnetic (LMAFM) phase occurs under pressure at a critical pressure P_c [3].

We have recently demonstrated that tuning URu_2Si2 by substitution of Fe for Ru offers an opportunity to study the HO and LMAFM phases at atmospheric pressure [4]. In this study, we conducted electrical resistance measurements on $URu_{2-x}Fe_xSi_2$ for H < 65 T using the pulsed field facility at the NHMFL in Los Alamos, in order to establish the temperature T vs. H phase diagram of $URu_{2-x}Fe_xSi_2$ under magnetic fields.

Results and Discussion

For low Fe concentrations, after the HO phase is suppressed; another feature is found that is likely associated with the crossover from non-Fermi-liquid to Fermi-liquid behavior, as seen for the parent compound. For high Fe concentrations, the HO phase seems to reenter after the suppression of AFM, and is also suppressed completely. Representative phase diagrams are shown in Fig. 1.

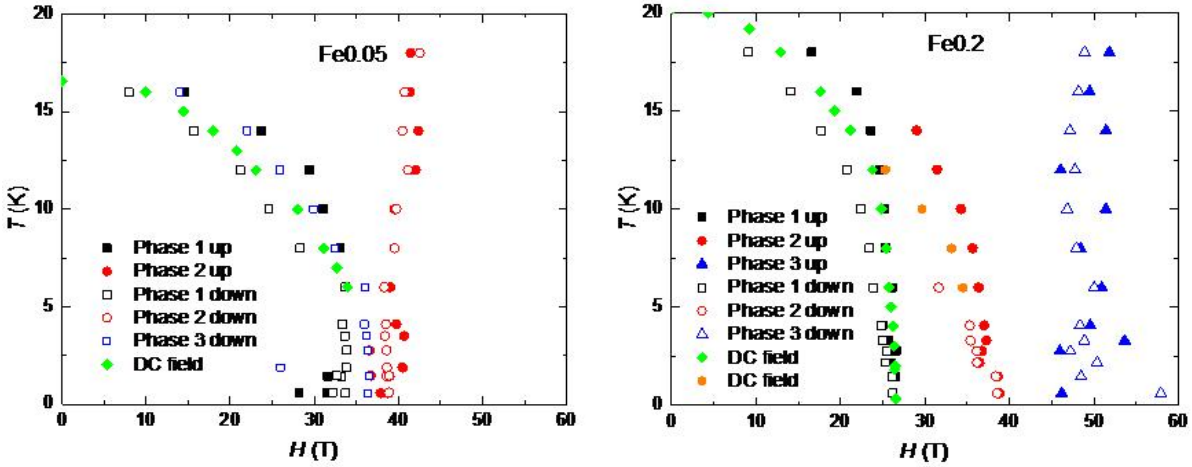

Fig. 1. Temperature T vs. magnetic field H phase diagrams for $URu_{2-x}Fe_xSi_2$ with x = 0.05 and 0.2.

Conclusions

We performed electrical transport measurements in high magnetic field on $URu_{2-x}Fe_xSi_2$ single crystals and established phase diagrams for the Fe substitution range of interest. In order to complete the phase diagram, we applied for 45 T hybrid field time and results are reported separately.

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