UPPER CRITICAL FIELD AND KONDO EFFECTS IN Fe($Te_{0.9}Se_{0.1}$) THIN FILMS BY PULSED FIELD MEASUREMENTS.

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Magnetism and superconductivity are intimately connected. In the context of S-wave order parameters, magnetism was considered to be detrimental to superconductivity, so much so that one of the famous Matthias Rules cautioned that magnetic elements were to be avoided when seeking new materials. The situation changed with the advent of heavy-Fermion superconductors and, likely, the cuprates where magnetism provides the pairing mechanism. With the discovery of iron-based superconductors, the Mathias Rule may well have been an impediment to their earlier discovery, rather than a helpful guide. The simplest of the Fe-based superconductors is the series Fe(Te,Se), which crystalize in simple iron-chalcogenide layers.

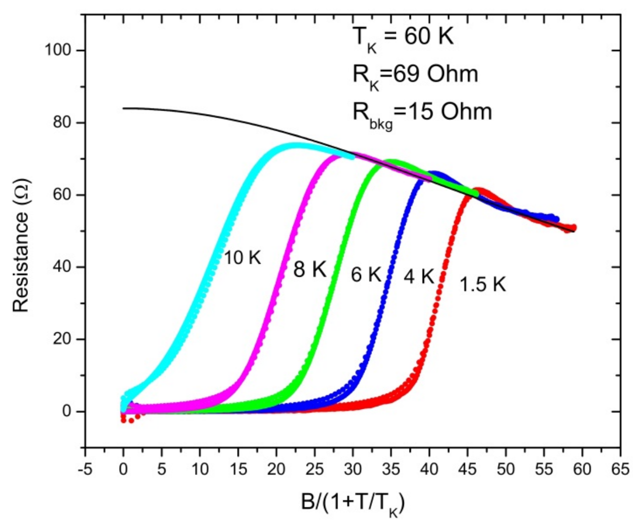

Figure 1. Resistance vs field scaled by reduced temperature. The solid line is a fit to an expression describing the Kondo resistance in magnetic fields, proposed by Felsh and Winzler. [2]

The transition temperatures of epitaxial films of Fe($Te_{0.9}Se_{0.1}$) are remarkably insensitive to applied magnetic field, leading to predictions of upper critical fields $H_{c2}(T=0)$ in excess of 100 T. Using pulsed magnetic fields, we find $H_{c2}(0)$ to be on the order of 45 T, similar to values in bulk material and still in excess of the paramagnetic limit. The same films show strong magnetoresistance in fields above $H_{c2}(T)$, consistent with the observed Kondo minimum seen for $T > T_c$. Fits to the temperature dependence in the context of the WHH model, using the experimental value of the Maki parameter, require an effective spin-orbit relaxation parameter of order unity. We suggest that Kondo localization plays a similar role to spin-orbit pair breaking in making WHH fits to the data. [1]

[1] M.B. Salamon, *to be published.*
[2] Felsch, W. & Winzer, K. Solid State Commun. **13**, 569-73 (1973).

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