Investigation of the reason for the anomalous phonon scattering in $Yb(In_{(1-x)}Cu_x)Cu_4$ single crystals.

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$YbInCu_4$ is well known for its first order isostructural phase transition at 40K with a change of the Yb-valence from +3 valid at room temperature to +2.9 in the low temperature phase [1]. This change of the electronic Yb state has a marked influence on various physical properties of this compound and has been investigated intensively by many groups during the last years. From phase diagram investigations[2] it is known that $YbInCu_4$ belongs to the system $Yb(In_{(1-x)}Cu_x)Cu_4$, crystallizing according to the AuBe5 type structure with the homogeneity range $0 \leq x < 0.7$. Doping of Cu on In-sites shifts the temperature of the valence transition from T_v=40K to values near 70K and changes the type of the transition from first order to continous second order like. Only low excess of Cu($0 \leq x < 0.2$) is permitted to observe the valence transition.

One of the still open questions concerns heat transport within this valence changing compound: Even in single crystals the phonon part of the heat conductivity ($\hat{e}_{ph}$) shows an increase with rising T proportional to $T^{1/3}$ like one would expect for amorphous materials[3].

To find the reason for the strong phonon scattering different approaches are used.
By careful analysis of temperature dependent x-ray diffraction date it is checked whether there is some hidden disorder present within the $AuBe_5$ structure of these crystals or whether more complicated structural models have to be applied to describe the valence changing Yb-In-Cu-compound.
In parallel it is investigated if interaction between phonons and valence instabilities can account for the unusual thermal transport properties of $YbInCu_4$.

References

[1] I. Felner and I. Nowik, Phys. Rev. B 33 (1986), 617
[2] A. Löffert, S. Hautsch, F. Ritter, and W. Assmus, Physica B 259 (1999), 134
[3] L. S. Parfeneva, I. A. Smirnov, H. Misiorek, J. Mucha, A. Jezowski, F. Ritter, and W. Assmus, Physics of the Solid State 44 (2003), 1212-1217