ABSTRACT CODE

Magnetic, transport and electronic properties of UNi_2

Slavomír Maťaš[1,2], Marián Mihalik[2], Matúš Mihalik[3], Karel Prokeš[1,3]

[1] *Hahn-Meitner-Institut, Berlin, Glienicker strasse 100,D-14109 Berlin, Germany*
[2] *Institute of Experimental Physics SAS, Watsonova 47, 04353 Košice, Slovak Republic*
[3] *Department of Electronic Structures, Charles University, Ke Karlovu 5, Prague, Czech Republic*

UNi_2 single crystal was grown by a Czochralski method in a tri-arc furnace. The crystal was investigated by elastic neutron diffraction (λ = 0.244 nm) on the two-axis difractometer E4 in HMI Berlin and by heat capacity and resistivity measurements in field up to 5 T on PPMS system in Prague.

Crystal structure determined from neutron diffraction data is consistent with expected $MgZn_2$ structure (space group $P6_3/mmc$). Our crystal is of good quality consisting of only one grain. The magnetic contribution to the integral intensity of reflections $I_M = I_T - I_{40K}$ is very weak, however we were able to follow the temperature dependence of this signal on top of the (1 0 2) reflection and found the magnetic phase transition at $T_c \approx 22$ K (Fig.1.). Magnetic moment of 0.077 μ_B/f.u. was obtained by normalisation of the additional integrated intensity of magnetic origin $I_M = I_{2K} - I_{30K}$ to the integrated intensity associated with the the nuclear Bragg peak I_{30K}. Determined Curie temperature and magnetic moment correspond very well with values determi- ed earlier from magnetisation data [1, 2].

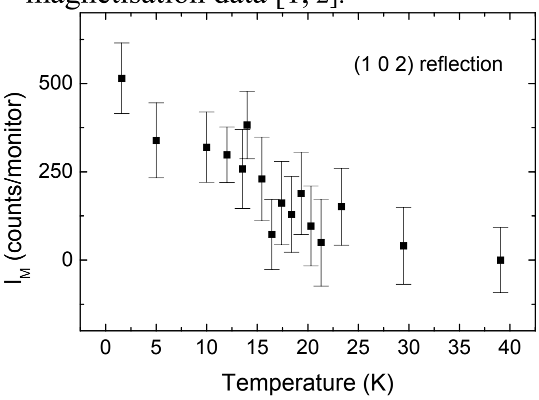

Fig.1. Temperature dependence of the magnetic contribution to the integral intensity of (1 0 2) reflection.

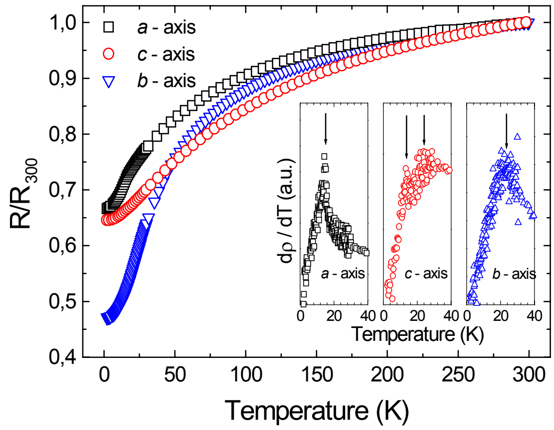

Fig.2. Temperature dependence of the electrical resistivity measured along main crystallographic axis; arrows in the inset points to anomalies connected with magnetic phase transition.

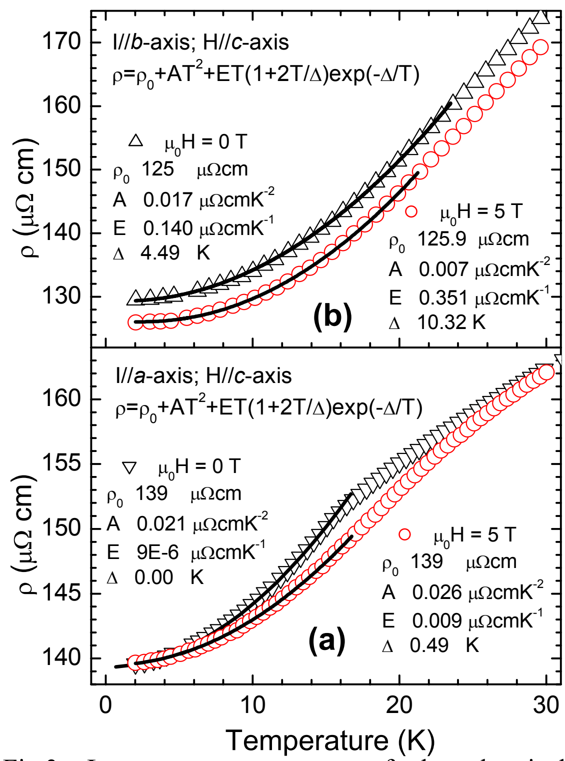

Fig.3. Low temperature part of the electrical resistivity below an anomaly can be described by equation written in picture. In the figure (b) the curve for $\mu_0H = 0$ T is shifted up about 4 μΩ cm.

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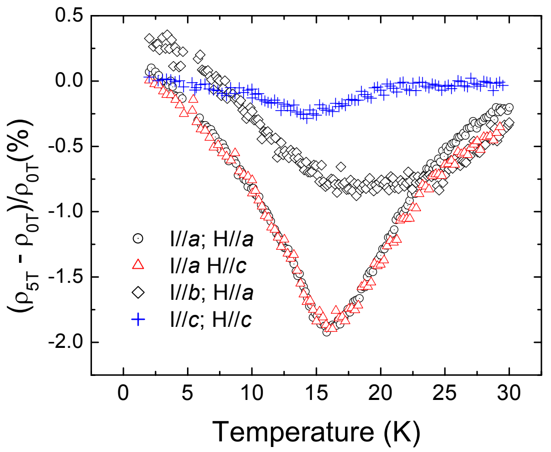

Fig.4. Temperature dependence of the magneto-resistivity measured along main crystallographic axis with different orientation of the magnetic field.

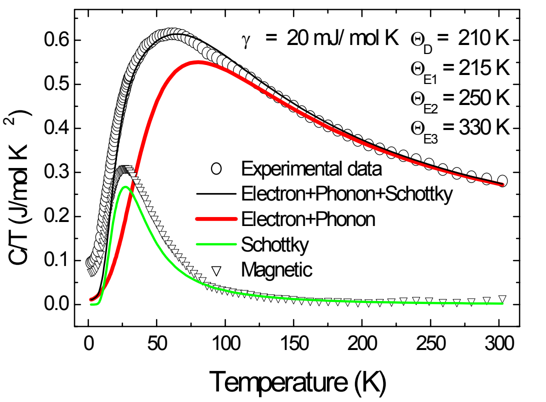

Fig.5. C/T vs T. The phonon part of specific heat was analyzed using the anharmonic approach [4].

The temperature dependence of the resistivity is strongly anisotropic (Fig.2.). The best ratio R_{300}/R_2 was found for the *b*-axis. With decreasing temperature the electrical resistivity decreases from room temperature first gradually to T ~ 80 K then sharp to T ~ 10 K, followed by a gradual decrease to lower temperatures. The transition to magnetic ordered state is accompanied by an anomaly, which is well visible in the *a*-axis resistivity (Fig.3a.) or in the temperature dependence of derivative (insets in Fig.2). General shape of ρ(T) curve is similar to results found on polycrystalline sample [3]. Below the anomaly the ρ(T) follows very well the equation given in figures (Fig.3). Quadratic term, describing contribution of ferro-magnetic magnons, is dominated for the *a*-axis and the *c*-axis; Δ term describing appearance of a gap in excitation spectrum, is important for the *b*-axis. With applied magnetic field the Δ term increases. Applied magnetic field smears out the anomaly and shifts it to higher temperatures. Both longitudinal and transversal magneto-resistances are negative, except for short interval below T=7K for the *b*-axis (Fig.4.).

C/T *vs* T dependence together with an analyse of possible contributions to heat capacity is displayed in Fig.5. The high temperature part of the specific heat can be successfully approximated with one Debye temperature, three Einstein temperatures and a γ given in Fig.5. A Schottky contribution to the heat capacity can be found below T = 85 K. The anomaly at about T ~ 15 K, associated with magnetic transition, is much more flatter as the same anomaly observed on a polycrystalline sample [2]. The heat capacity data below the anomaly can be describe by a formula $C/T = \gamma + \beta T^2 + fT^{1/2}\exp(-\Delta/T)$ with γ = 92 mJ/molK and Δ = 6.8 K. The enhanced value of γ can be attributed to magnetic ordering. Applied field shifts the anomaly to higher temperatures.

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References

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