SEMINARIUM Z MAGNETYZMU I NADPRZEWODNICTWA

Uprzejmie zawiadamiamy, że w **środę**

18 listopada 2020 r., o godz.10:00

odbędzie się seminarium **on-line (link podany jest na stronie IF PAN)**,

na którym

dr hab. Hoa Kim Ngan Nhu-Tarnawska, prof. UP

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wygłosi referat na temat:

Why the cubic phase of uranium?

Physical properties of metallic uranium crystallized in the orthorhombic structure (α-U) were known, since this phase exists at room temperature, e.g. the superconductivity in the natural uranium was first discovered in 1942 (T_c=1.3 K). The body-centered cubic phase of Uranium (bcc; γ-U) is stable only at high temperatures (1045-1405 K). The large interest in the U-based systems with the γ-U phase was started from the search of materials fulfilling the requirements of using the low enriched uranium (LEU, <20% U) fuel for research nuclear reactors, since they have a higher thermal conductivity and higher resistance to irradiation. From a fundamental standpoint, it is of interest to determine the basic thermodynamic properties of these systems, since they exhibit a superconducting ground state around 2 K. Most of the data, however, were obtained since more than half century ago.

Recently, we success to stabilise the γ-U phase in U-T systems (T = Mo, Nb, Zr, Ru, Pt, Ti) at room temperature by a combination of using (minimal possible) T concentration and splat cooling technique with a cooling rate of about 10^6 K/s [1]. All samples undergo superconducting phase transition [2,3]. The highest critical temperature (T_c = 2.1 K) was found in U-15 at.% Mo, and the specific heat jump in this compound is in a good agreement with that expected from BCS theory. The upper critical magnetic field in these system ($\mu_0 H_{c2}(0)$) is in the range of 2 - 7 T, and the slope at T_c ($-\mu_0(dH_{c2}/dT)_{Tc}$) is about 2 - 5 T/K.

The U-T system can absorb a large amount of hydrogen, but only at high hydrogen pressures above 2.5 bar forming hydrides of the $(UH_3)_xT_{1-x}$ type. These hydrides are ferromagnetic with the Curie temperature around 200 K [4,5]. The U-magnetic moment is about $1\mu_B$/U (much smaller than the expect value ~ $3{,}2\mu_B$/U for f^{2+} and/or f^{3+} ground state). It is important from the application viewpoint that these hydrides are not piroforic, it is easy and safe to handle them. Hydrogen is easily released by annealing at high temperatures and in vacuum [6].

The research was conducted in the scope of e.g. Czech-Polish project ID(CZ) 7AMB14PLO36. Experiments were performed in Charles University in Prague and in ACMiN, AGH-Kraków (down to 70 mK).

[1] N.-T.H. Kim-Ngan et al., JALCOM 580 (2013) 223.
[2] N.-T.H. Kim-Ngan et al., JALCOM 645 (2015) 158.
[3] N.-T.H. Kim-Ngan et al., J. Nucl. Mater. 479 (2016) 287.
[4] I. Tkach et al., PRB 88 (2013) 060407(R).
[5] I. Tkach et al., PRB 91 (2015) 115116.
[6] N.-T.H. Kim-Ngan et al., Physica B 545 (2018) 152.

Serdecznie zapraszamy
Roman Puźniak / Andrzej Szewczyk