日本物理学会九州支部特別講演会

第9回 九州大学理学部物理学教室談話会

講演題目： **High-field magnetization of Tm_2Fe_{17} single crystal**

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日 時：12月 19日 (木) 15：00－16：30
場 所：九州大学理学部 2号館 物理学教室 第一会議室
（福岡市東区箱崎6-10-1）

講演概要：

The R_2Fe_{17} compounds, where R is a rare-earth element, crystallize in either the Th_2Zn_{17} or the Th_2Ni_{17} structure type, depending on the size of the rare earth atom. They were extensively investigated in the 1960-80ies and nowadays they are still a matter of active research. Most of these compounds exhibit ferro- or ferrimagnetic order with rather moderate Curie points, slightly above room temperature. Like other R_2Fe_{17} with heavy rare earths, Tm_2Fe_{17} has the hexagonal Th_2Ni_{17}-type crystal structure (space group $P6_3/mmc$). The structure consists of Tm-Fe layers separated by distorted Kagome nets of Fe atoms. Pairs of Fe atoms on the 4*f* sites (the so-called “dumbbells”) and the Tm(2*d*) atoms make alternating chains running along the *c* axis. There is another group of parallel, purely Tm chains consisting of the Tm(2*b*) atoms.

Tm_2Fe_{17} is a ferrimagnet with T_C = 295 K and a spontaneous moment of 22 μ_B/f.u. at T = 1.5 K. Tm_2Fe_{17} is unique among the R_2Fe_{17} compounds in being an easy-axis ferrimagnet. The easy-axis anisotropy is stable only below 75 K. Due to competing magnetic anisotropy of the Tm and Fe sublattices, a spin-reorientation occurs at higher temperatures. It is a continuous process involving two second-order phase transitions, at T_{SR1} = 75 K (easy axis – easy cone) and T_{SR2} = 105 K (easy cone – easy plane).

In the present work we have studied the magnetization of a single crystal of Tm_2Fe_{17} in steady (14 T) and pulsed (60 T and, in one case, up to 74 T) magnetic fields at temperatures between 2 and 300 K. Of particular interest are low-temperature magnetization curves along the *c* axis. Three metamagnetic transitions, at 41, 53.5 and 65 T, are observed at 2 K. The magnetization above the last transition reaches practically the sum of Tm and Fe sublattices, 50 μ_B (forced ferromagnetic state). We propose that the second transition is a coincidence of 2 transitions, so in total there are 4 transitions corresponding to demagnetization and then magnetization in opposite direction of two individual Tm sublattices. At each transition, the magnetization increases with magnetic field in broad steps whose heights correspond roughly to the atomic moment of Tm, $\mu_{Tm} = 7\ \mu_B$. The positions of the steps yield information on the Fe-Tm molecular field, 48 T on the Tm 2*d* site and 60 T on the Tm 2*b* site.

談話会後，食事会を予定しています． 出席ご希望の方は下記までご連絡ください．

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