Crystallization of $(Th_{1-x}U_x)_3As_4$ ferromagnetic semiconductor from the Ga-flux

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U_3As_4 is a low-carrier ferromagnet showing high anisotropic magnetoresistivity [1]. Th-rich $(Th_{1-x}U_x)_3As_4$ solid solutions (up to x=0.15) grown by the modified Van Arkel method [2] remain non-ferromagnetic semiconductors down to 4 K. Expecting coexistence of semiconducting and ferromagnetic properties, promising interesting spintronic-oriented features, in U-reach $(Th_{1-x}U_x)_3As_4$ solutions [3] we examined a possibility of growing them from the Ga-flux.

In two experiments Th:U:As:Ga melts with atomic ratios 1:2:4:7 and 1:2:6:7, kept in alumina crucibles sealed in quartz ampoules, were cooled from 1080 to 500°C. The second experiment resulted in higher amount of the ferromagnetic phase present in two characteristic forms. The first form consisted of $(Th_{0.2}U_{0.8})_3As_4$ single crystals partially immersed in a surface of large (≈2 mm) GaAs crystal (see Fig. 1a). Temperature dependence of magnetization of that composite is shown in Fig. 2. The second form looked like pieces of broken sphere, whose concave surface was formed of larger crystals with sharp edges (see Fig. 2b), and thermoelectric power S≈+35 μV/K, while the convex surface was formed of small crystals with Th_3P_4-type crystal structure identical with that of the first form, and thermoelectric power S≈-20 μV/K.

Thus the growth from Ga-flux occurrs to be easier than the Van Arkel method [2] to grow either *n*- or *p*-type ferromagnetic semiconductor $(Th_xU_{1-x})_3As_4$. It opens new route to learn more on its interesting spintronic properties.

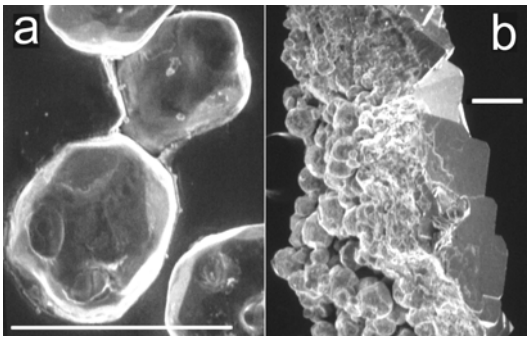

Fig. 1. SEM images of $(Th_{1-x}U_x)_3As_4$ crystals (bars represent 0.1 mm)

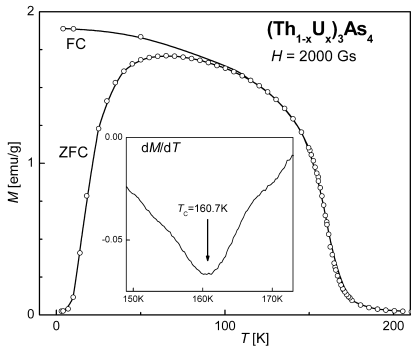

Fig. 2. Temperature dependence of magnetization (sample from Fig. 1a, x=0.8).

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[2] P. Markowski, Z. Henkie and A. Wojakowski, Solid State Commun. **32** (1979) 1119
[3] P. Wiśniewski and Z. Henkie, Mater. Sci. Poland (in press)

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