

New material research in the actinide compounds

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We will report the progresses of the new material research in the actinide compounds. In the process of the single crystal growth of actinide compounds, the amount of raw actinide materials should be reduced as much as possible. Considering this point, the flux method is one of the most useful methods. In order to develop the new actinide compounds include the filled skutterudite, we have been searching the suitable flux and conditions for growing the single crystal. In these trial processes, we confirmed that Sn-flux method is applicable to UFe₄P₁₂ and NpFe₄P₁₂.¹ We also found that Pb-flux is good for the Pd compound, such as UPd₃. Using this Pb-flux, we accidentally discovered the new neptunium superconductor NpPd₅Al₂.² This compound has ZrNi₂Al₅-type tetragonal structure as shown in Fig. 1. This compound is found to be a paramagnetic heavy-fermion superconductor with strong coupling $\Delta C/\gamma T_c = 2.33$ [$T_c = 4.9$ K and $\gamma = 200$ mJ/K²·mol]. The upper critical field H_{c2} at 0 K is large and highly anisotropic: $H_{c2} = 37$ kOe for $H_{c2} \parallel [100]$ and $H_{c2} = 143$ kOe for $H_{c2} \parallel [001]$, and strongly suppressed by the magnetic field. Furthermore, we have succeeded to grow some of the other single crystals of rare-earth and actinides compounds. For example, the single crystal of UCu₂Si₂, UCu₂Ge₂, ThCu₂Ge₂, CeCu₂Si₂, and RCu₂Si₂ were grown by the Sn-flux method. In the case of UCu₂Si₂ and YbCu₂Si₂, the de Haas-van Alphen signals are detected by using these crystals. Recently, we succeeded in growing the superclean single crystal of URu₂Si₂ by the Czochralski-pulling method in a tetra-arc furnace and detecting the de Haas-van Alphen signal. We will also report the recent progresses of the crystal growth of Pu compounds.

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