

**Investigation of novel quantum states in
actinide-based compounds with unstable valence**

Noriaki SATO

(Nagoya University, Graduate School of Science, Professor)

【Outline of survey】

Magnetism and superconductivity have both received much interest in the field of condensed matter physics. An actinide-based material is believed to show intermediate nature between itinerant- $3d$ and localized- $4f$ element based materials. However, its true nature is yet to be clarified. This is because the radio activity of the actinide element makes experiments difficult to perform. Nevertheless, a challenging effort has revealed that there are novel actinide-based compounds, that is, (anti)ferromagnets exhibiting the coexistence with superconductivity. Understanding of the interplay between magnetism and superconductivity is an attractive challenge for solid state physicists. Recognizing this situation, this project aims to explore the electronic states of the actinide-based compounds with unstable valence. For that purpose, we establish a station for the single crystal growth that is authorized to handle actinide materials. Further we plan to develop a redox flow battery.

【Expected results】

By establishing an actinide investigation center to prepare a good-quality single crystal of actinide compounds and provide them to a researcher of the field, the actinide research in Japan is expected to keep active. It is also expected that the resolving of problems characteristic of the actinide materials, including the interplay between ferromagnetism and superconductivity, makes substantial influence on other fields of the solid state physics. It is further expected that the development of a redox flow battery will open up a new road to the reuse of actinide materials.

【References by the principal investigator】

- Stoner gap in the superconducting ferromagnet UGe_2 ,
N. Aso, N. K. Sato *et al.*, Phys. Rev., **B73** (2006) 054512-1-5.
- Strong coupling between local moments and superconducting ‘heavy’ electrons in UPd_2Al_3 ,
N.K. Sato, F. Steglich, P. Fulde *et al.*, Nature, **410** (2001) 340-343.

【Term of project】 FY2008—2012

【Budget allocation】

149,900,000 yen (direct cost)

【Homepage address】

<http://mlbp.phys.nagoya-u.ac.jp/>