【Science and engineering（Mathematical and physical science）】

Exotic Superconducting State of Heavy Fermion Compounds

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【Outline of survey】

In rare earth or actinoid intermetallic compounds, the effective mass of the electrons can be strongly enhanced due to the hybridization between the *f*-electrons and conduction *d*- or *s*- electrons; the so-called "heavy-fermion" state is realized. The heavy fermion compounds often show a superconductivity and their superconducting state exhibits a rich variety of unusual properties. Although the study of the heavy fermion superconductors has started nearly 30 years ago, the research is facing a new phase, because many of them were discovered after it had become the 21st century. Heavy fermion superconductivity is one of the most basic problems in physics, because it is closely related to the Bose-Einstein condensate of atomic gases and high energy physics. Therefore its clarification becomes a key to the understanding of the novel condensed states of the material. In this research, heavy fermion artificial superlattice are fabricated to clarify the exotic superconducting state of these systems. In addition, new experiment technique are developed to probe the exotic superconducting states.

【Expected results】

By fabricating the artificial superlattice whose basic unit is heavy fermion compounds, we are able to create novel electronic systems, particularly systems which show unprecedented superconducting properties, including spatially non-uniform superconducting state and superconducting state without inversion symmetry. We will investigate these systems systematically by the electron transport, magnetic, optical reflection, nuclear magnetic resonance measurements. These studies enable us to make understanding of the novel superconducting state of the heavy fermion compounds advance greatly.

【References by the principal investigator】

・Angular Position of Nodes in the Superconducting Gap of Quasi-2D Heavy-Fermion Superconductor $CeCoIn_5$, K. Izawa, H. Yamaguchi, Yuji Matsuda, H Shishido, R. Settai, and Y. Onuki, Phys. Rev. Lett. 87, 057002 (2001)

【Term of project】 FY2008－2012	【Budget allocation】 165,200,000 yen (direct cost)

【Homepage address】 http://kotai2.scphys.kyoto-u.ac.jp/index.php