

Syllabus

Magnetic properties of rare earth compounds - basics and application

Hideaki Kitazawa

Quantum Beam Unit, NIMS

The lanthanides elements from La to Lu which are located at the bottom of the periodic table are often called as rare earth elements. Despite their name, rare earth elements (with the exception of radioactive promethium) are relatively plentiful in Earth's crust. Since their electronic states of in the substance mostly prefer to the trivalent state in the substance, rare earth compounds often show the similar chemical properties. However, their magnetic properties are quite variable depending on lanthanides elements, for instance, from the permanent magnet $\text{Nd}_2\text{Fe}_{14}\text{B}$ to the heavy fermion superconductor CeCu_2Si_2 . Especially the development of Dy-free permanent magnet based on $\text{Nd}_2\text{Fe}_{14}\text{B}$ holds extremely important clues to build a sustainable world because Dy is eccentrically-located element in the world.

Their magnetic properties are mostly governed by the well-localized f electrons in an outer shell. Therefore their magnetism can be often understood by the localized model. However, lots of exotic rare earth compounds which show the itinerant behavior through interaction of conduction electrons have been explored. In order to understand their magnetic properties of rare earth compounds, we have to use quantum mechanics. I will introduce the basic idea of their magnetism. Secondly I will introduce some activity using the hybrid magnet in NIMS. On the other hand, neutron scattering is a powerful tool to study microscopic properties of magnetic substances. I will introduce the basic of the neutron scattering. Finally I will demonstrate our recent topics of rare earth magnetic materials which show geometrically frustration behavior and giant magnetocaloric effect using high-magnetic field and neutron scattering.

1. Introduction of magnetism I
2. Introduction of magnetism II
3. High-field study of rare earth compounds
4. Introduction of neutron scattering
5. Some example of neutron scattering study for rare earth compounds

