Magnetism

Prof. **Hiroyuki Nojiri** (2004.4～)

【Staff Members】

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【Research Activities】

Major research subjects of our group are study of magnetism under very strong magnetic fields and the material processing by using high magnetic fields.

In magnetism, the research has been focused on the search of new nano-magnets and on investigation of the quantum mechanical properties. Main results are as follows. (1) Discovery of spin tube and spin prism and the examination of the magnetic properties (**Ref.*1***), (2) Study of quantum tunneling and quantum hysteresis in spin triangles, which appears for spin chirality (**Ref.*2***), (3) Investigation of spin polyhedrons, especially the size effect and the ground state (**Ref.*3***), (4) Study of spin parity effect in single molecular magnets by using high frequency ESR.

These researches have been performed as the domestic and international collaborations with more than 10 groups. It has been established that time-dependent magnetic fields are a unique and useful tool to manipulate nano-spin systems quantum mechanically.

Magnetoelectropolymerization of conducting polymers has been studied as applications of magnetic fields to materials processing. We have found that magnetoelectropolymerized polyaniline films exhibit ability of enantioselective recognition for chiral molecules (**Ref.*4***).

A compact pulsed field generator has been developed for high magnetic field X-ray diffraction experiments. The world record of 33 T has been achieved at SPring8 facility. (**Ref.*5***)

1. J. Schnack, H. Nojiri, P. K Gerler, Geooerey J. T. Cooper, Leroy Cronin
Magnetic characterization of the frustrated three-leg ladder compound [(CuCl2tachH)3Cl]Cl2
Phys. Rev. B 70 (2004)174420(5 pages).

2. T. Yamase, E. Ishikawa, K. Fukaya, H. Nojiri, T. Taniguchi, T. Atake
Spin-Frustrated $(VO_3)^{6+}$-Triangle-Sandwitching Octadecatungstates as a New Class of Molecular Magnets
Inorg. Chem. 43 (2004) 8150-8157.

3. C. Schroder, H. Nojiri, J. Schnack, P. Hage, M. Luban, P. Koegrler
Competing Spin Phases in Geometrically Frustrated Magnetic Molecules
Phys. Rev. Lett. 94 (2005) 017205(4 pages).

4. I. Mogi and K. Watanabe
Chirality of Magnetoelectropolymerized Polyaniline Electrodes
Jpn. J. Appl. Phys., 44 (2005) L199-L201.

5. T. Inami, K. Ohwada, Y. H. Matsuda, Y. Ueda, H. Nojiri, Y. Murakami, T. Arima, H. Ohta, W. Zhang, K. Yoshimura
X-ray Diffraction Experiments under Pulsed Magnetic Fields above 30 T
Nucl. Instrum. and Methods (2005) to be published.

【Plan】

The aims of our group are study of magnetism under very strong magnetic fields and the material processing by using high magnetic fields. Toward these purposes, following plans have been made.

(1) Study of nano-scale magnet

It is important to find out nano-magnets with new topology. For example, spin tube, spin prism and spin polyhedron are very important When antiferromagnetic interactions are dominating in those systems, various metastable states are expected to appear because of the frustration and of the degeneracy of energy levels. It is interesting to study the quantum dynamics of such systems, especially the quantum tunneling of magnetization.

(2) Control of quantum dynamics

The most important but most difficult breakthrough in nano-magnetism will be the control of decoherence. A time depending magnetic field can be a unique tool for the quantum mechanical manipulation of spins. New methods should be developed to solve the "decoherence problem".

(3) Material processing by using high magnetic fields

It is important to search a new material processing process by using magnetic fields, such as magnetoelectropolymerization in high magnetic fields. New functions will be attached by using such synthetic process.

(4) Development of high field X-ray diffraction system

The combination of X-ray and magnetic field will be a powerful tool to investigate various phase transitions. For this purpose, a compact pulsed magnetic field generator should be developed. Intense research and development efforts should be made to combine the pulsed magnetic fields and the synchrotron X-ray.

(5) Wide Research collaboration in nano-magnetism

It is important to establish the wide collaboration among different research groups in the field of nano-magnetism. The magnetism division of IMR will be one of the centers in this research field.