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Novel functionalities on metal complex material and metal oxide-based nanomaterial

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Abstract

The study of functional materials is an important issue in the field of solid state science. Up to date, we have reported various unique magnetic functionalities using cyano-bridged bimetallic assembly.[1-3] Furthermore, we have observed a photo-reversible metal-semiconductor phase transition at room temperature in λ-Ti_3O_5.[4] In addition, we have developed a pure phase of □-iron oxide nanomaterials, which exhibit a gigantic magnetic coercive field and high frequency millimeter wave absorption.[5,6]

Photogmagnetism based on cyano-bridged bimetal assembly

Spontaneous bulk magnetization due to light-induced spin-crossover was observed in a metal-organic framework (MOF) based on a three-dimensional Fe-Nb bimetallic assembly, $Fe_2[Nb(CN)_8]\cdot(4\text{-pyridinealdoxime})_8\cdot 2H_2O$[3]. This photomagnet showed magnetic phase transition at 20 K, which originates from the long-range magnetic ordering between the Fe^{II}_{HS} sites through −NC−Nb^{IV}(S=1/2)−CN− bridge.

Gigantic coercive field and high frequency millimeter wave absorption based on □-Fe_2O_3

Rh-substituted ε-Fe_2O_3, ε-$Rh_xFe_{2-x}O_3$ nanomagnets was prepared by a nanoscale chemical synthesis.[6] ε-$Rh_xFe_{2-x}O_3$ nanomagnets exhibit a huge H_c of 27 kOe at room temperature. Furthermore, a crystallographically oriented sample recorded an H_c value of 31 kOe, which is the largest among metal-oxide-based magnets and is comparable to those of rare-earth magnets. In addition, ε-$Rh_xFe_{2-x}O_3$ shows the highest zero-field ferromagnetic resonance frequency, resulting in high frequency millimeter wave absorption and magnetic rotation above 200 GHz.

(1) S. Ohkoshi, et al., ***Nature Materials***, 3, 857 (2004). (2) S. Ohkoshi and H. Tokoro, ***Accounts Chem. Res.***, 45, 1749 (2012). (3) S. Ohkoshi, et al., ***Nature Chemistry***, 3, 564 (2011). (4) S. Ohkoshi, et al., ***Nature Chemistry***, 2, 539 (2010). (5) S. Ohkoshi, et al., ***Angew. Chem. Int. Ed.***, 46, 8392 (2007). (6) A. Namai, et al., ***Nature Communications***, 3, 1035 (2012).

Biography

Shin-ichi Ohkoshi is a Professor of Chemistry at The University of Tokyo. He received his PhD from Tohoku University in 1995. In 1997, he moved to The University of Tokyo as a Research Associate, and became a Lecturer in 2000. In 2003, he was promoted to an Associate Professor, and since 2006, he has been a full Professor in the Department of Chemistry at The University of Tokyo. He has received the Young Scientists' Prize in 2005 by MEXT of Japan, JSPS Prize in 2008, Japan Academy Medal in 2008, and IBM Japan Science Prize in 2009. He served as an invited Professor at the University of Bordeaux I, France in 2007, the University of Pierre and Marie Curie, France in 2008, and has been an Honorary Professor of Durham University, UK since 2009.