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Design and development of novel functional metal oxide nanoparticles

Development of functional materials has been an attractive issue in the fields of chemistry, physics, and materials science. We have reported various unique magnetic functional materials using cyanido-bridged bimetallic assemblies. Furthermore, we have developed a pure phase of epsilon-iron oxide (ε-Fe_2O_3) nanomagnets exhibiting large coercivity and high-frequency millimeter wave absorption, and have developed a novel titanium oxide, lambda-trititanium pentaoxide (λ-Ti_3O_5) showing photo-reversible metallic-semiconductor phase transition at room temperature and heat-storage properties. This talk this will focus on the synthesis and functionalities of λ-Ti_3O_5. A novel phase of Ti3O5 (λ-Ti_3O_5) was prepared as nanoparticles. By alternatively irradiating with 532 nm and 410 nm lights, phase transition between λ-Ti_3O_5 (black, metallic conductor) and beta(β)-Ti_3O_5 (brown, semiconductor) was repeatedly observed at room temperature. Thermodynamical analysis suggests that λ-Ti_3O_5 is a trapped phase at a local energy minimum. Light irradiation causes the reversible switching between this trapped state (λ-Ti_3O_5) and the other energy minimum state (β-Ti_3O_5). Furthermore, we have recently reported that the reversible switching is also induced by other external stimulation such as pressure, and have found that this material exhibits high performance heat storage properties, which are understood from thermodynamic studies.

Recent Publications

1. S Ohkoshi et al., (2012) Photomagnetism in cyano-bridged bimetal assemblies. Accounts of Chemical Research 45:1749-58.
2. S Ohkoshi et al., (2011) Light-induced spin-crossover magnet. Nature Chemistry 3:564-69.
3. S Ohkoshi et al., (2004) Humidity-induced magnetization and magnetic pole inversion in a cyano-bridged metal assembly. Nature Materials 3, 857-61.
4. A Namai, S Ohkoshi, et al., (2012) Hard magnetic ferrite with a gigantic coercivity and high frequency millimetre wave rotation. Nature Communications 3, 1035.
5. S Ohkoshi et al., (2015) Nanometer-size hard magnetic ferrite exhibiting high optical-transparency and nonlinear optical-magnetoelectric effect. Scientific Reports 5, 14414.

Biography

Shin-Ichi Ohkoshi holds the position of Vice Dean, School of Science, The University of Tokyo; Professor in Department of Chemistry, School of Science, The University of Tokyo and; Director of Cryogenic Research Center, The University of Tokyo. He has published 429 papers, 175 patent applications, 177 invited presentations, and 57 h-index. His research interests are in the areas of inorganic chemistry and physical chemistry, i.e., magnetic materials, phase transition materials, nanomagnetic materials, light-induced phase transition, etc.

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