SUMMARY OF Ph.D. DISSERTATION

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Title

Magnetic structure and magnetization reversal process in ferromagnetic nano-network system

Abstract

Well defined nanometer-size ferromagnetic systems, so-called nanomagnets, provide effective ways to explore magnetics because of ideally controlled domains in the system, and the magnetic properties of nanomagnets have been studied extensively. Few researches have been performed on the ferromagnetic nano-network systems because network system has the strong magnetic interaction among elements. The magnetic interaction among nanomagnets, which can be considered simply, can be applied to new devices e.g. magnetic logic devices.

In this study, ferromagnetic honeycomb nano-networks and nanometer-scale antidot array systems have been investigated. The honeycomb system contains orderly arranged vertices connected to three ferromagnetic nano-wires. We prepared the antidot systems with various antidot pitch and arrangement.

Magnetic-force microscopy shows that no domain walls exist in the wire part of the honeycomb nano-network. This indicates that the magnetic structure of this system is described in terms of the uniform magnetic moments like spins and the magnetic interaction among the wires at the vertex. This result clarifies the magnetic interaction at the vertices governs the magnetic structure of the system and that the magnetic properties of the system correspond to the Ising-spin model on a kagomé lattice. The magnetoresistance measurement clarifies that the magnetization process of the honeycomb system are governed by the magnetic-ice rule at the vertices. We demonstrate that the magnetic-ice rule is controllable by varying the magnetic interaction in the vertices.

Magnetization loops of the antidot array systems demonstrate that the magnetic properties can be changed dramatically by varying the antidot pitch and the arrangement. The torque curve clarifies that the magnetic anisotropy energy caused by antidot is 3.2×10^4 J/m^3.