【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering)

Title of Project : New development of ordered-alloy materials for spintronics

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Research Area : Materials science and engineering
Keyword : Magnetic materials, spintronics, ordered alloys

【Purpose and Background of the Research】

Spintronics is attracting much attention as a new electronics, leading to next-generation information & communication technology. Fe, Co, Ni, and their random alloys are typically used as magnetic materials for spintronics, however they have limitations for functionalities. We are interested in order alloys and explored new functionalities by employing $L2_1$ type Heusler alloys as materials with high spin-polarization and $L1_0$ type ordered alloys as materials with large magnetic anisotropy. In this study, we aim to develop new materials with higher and/or more functionalities by employing $C1_b$ type Heusler alloys and $L1_1$ type ordered alloys. In addition, we work on "spin caloritronics" dealing with the relation between heat and spin, and try to yield a high functionality for spin caloritronics.

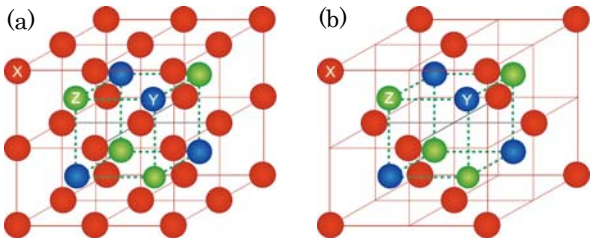

Fig.1 Crystal structures of (a) $L2_1$ type Hesuler alloy and (b) $C1_b$ type Hesuler alloy.

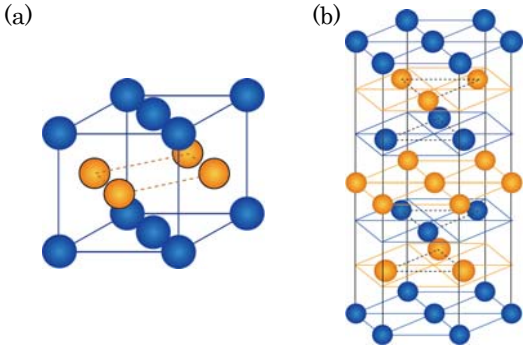

Fig.2 Crystal structures of (a) $L1_0$ type ordered alloy and (b) $L1_1$ type ordered alloy.

【Research Methods】

For three purposes, that is, the development of higher functionality, more functionalities and spin caloritronics, each study will be performed in parallel and correlated with each other. As for the development of highly functional materials, improvement of CPP-GMR for devices including $L2_1$-Co_2MnSi will be continued in FY2013, and $C1_b$ type Heusler alloys such as CoMnSb will be employed after FY2014. As for the development of multi-functional materials with high magnetic anisotropy and low damping, the fabrication of $L1_1$-CoNi epitaxial thin films by MBE will be tried in FY2013. After FY2014, fabrication of highly textured $L1_1$-CoNi films on glass substrates by sputtering will also be tried from a practical viewpoint. As for the development of spin caloritronics, Peltier cooling effect and anomalous Nernst effect will be studied for the ordered alloys in each FY, and a guiding principle for the development of new materials will be systematically investigated.

【Expected Research Achievements and Scientific Significance】

The development of new materials with higher and/or more functionalities in $C1_b$ type Heusler alloys and $L1_1$ type ordered alloys is expected. Moreover, material dependence will be systematically clarified in spin caloritronics, which is now an emerging field. The achievement of this study will lead to new development of spintronics.

【Publications Relevant to the Project】

・"Heusler alloys as materials for spintronics", Y. Sakuraba and K. Takanashi, in Heusler alloys as functional materials (ed. T. Kanomata, Uchida-rokakuho, 2011), Chap. 9, 233-270.
・"Magnetic Anisotropy and Chemical Order of Artificially Synthesized $L1_0$-Ordered FeNi Films on Au-Cu-Ni Buffer Layers", T. Kojima, M. Mizuguchi, T. Koganezawa, K. Osaka, M. Kotsugi, and K. Takanashi, Jpn. J. Appl. Phys. (Rapid Comm.), **51** (2012) 010204.

【Term of Project】

FY2013-2017

【Budget Allocation】

168, 400 Thousand Yen

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