平成 20 年 6 月 10 日

応用物理学会北海道支部
会員各位

応用物理学会北海道支部

講演会のお知らせ

下記講演会を開催いたしますので、多数ご参加下さいますようご案内申し上げます。

講演題目　：Semiconducting and half metallic Heusler compounds
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開催日時　：平成 20 年 6 月 23 日（月）　13:30～14:30
開催場所　：北海道大学情報科学研究科 11 階会議室 (11-17)
主催　　：応用物理学会北海道支部

講演要旨　：
The development of magnetic Heusler compounds specifically designed as materials for spintronic applications has made tremendous progress in the very recent past [1]. Recently Half Heusler compounds are discussed as potential candidates for thermoelectric applications [2].
Half-metallic ferromagnetism was first discussed for the C1b compound NiMnSb
[3]. Half metallic ferromagnets behave like metals with respect to the electrons of one spin direction and like semiconductors with respect to the electrons of the other spin direction. C1b compounds of composition XYZ (X=metal, mostly transition or rare earth metals; Y=transition metals, Z=main-group element) consist of three interpenetrating fcc lattices. From the viewpoint of electronic structures, the most appropriate description of these compounds is as a zinc-blende YZ lattice stuffed with X atoms. The compounds can be thought of as comprising X(^n+) ions stuffed in a zinc-blende-type [YZ](^n-) sublattice, where the number of valence electrons associated with the [YZ](^n-) sublattice is 8 or 18 (d(^10)+s(^2)+p(^6))
[4]. Such closed-shell 18-electron compounds are nonmagnetic and semiconducting. The prototypes for a nonferromagnetic compound are LiAlSi and CoTiSb.
Most of the magnetic and half-metallic C1b compounds contain manganese or a rare earth. This is not accidental because, as described by Kubler et al.[5] the properties of the manganese ions in the Y position of the Heusler compounds must be taken into account. These manganese ions, which have an approximate Mn(^3+) configuration, have a highly localized moment that ranges from 3 - 4 uB. The rare-earth ions (RE) in C1b compounds (for example, RENiSb or REAuSn) also exhibit a charge of +3 and a magnetic moment corresponding to localized f states [4].
Heusler compounds have the chemical formula X2YZ (X, Y=transition metals, Z=main-group element) [5]. Ordered Heusler compounds crystallize in the L21 structure [6]. The additional X atom fills the remaining tetrahedral vacancy in the C1b (XYZ) structure.
The development of magnetic Heusler compounds specifically designed as materials for spintronic applications has made tremendous progress in the very recent past [7]. Heusler compounds can be made as half-metals, showing a high spin polarization of the conduction electrons of up to 100% in tunnel junctions [8]. High Curie temperatures were found in Co2-Heusler compounds with values up to 1120 K in Co2FeSi [9]. The latest results at the time of writing are a TMR device made from the Co2FeAl0.5Si0.5 Heusler compound and working at room temperature with a TMR effect higher than 200% [10]. However Aluminum containing Heusler compounds show B2 disorder. The solid solutions of Co(2-x)Fe(1+x)Si Heusler compounds, a half-metallic alloy with high Curie temperature are possible candidates for a high tunnel magneto resistance (TMR) effect [12]. This compound is perfectly ordered proven by Mossbauer spectroscopy which

is a precondition for a high spin polarization.
Ferrimagnetic Heusler compounds are candidates for spin torque application, because of the low magnetic moments. The high Curie temperatures make these Heusler promising materials for Spin torque applications. Mn3Ga with Heusler structure was predicted to be a half metallic compensated ferrimagnet [12].
However the synthesized material is tetragonal distorted, but still a suitable material for spin torque transfer applications. The material is hard magnetic and has a saturation magnetization in average about 1/4 uB/at. The Curie temperature is above the decomposition temperature of about 730 K. The electronic structure calculation indicates a ground state with ferrimagnetic order and 88% spin polarization at the Fermi Energy [12,13].

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