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種別(和文)	論文要旨
Type(English)	Summary

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（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	材料工学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　工学　）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

During last decades, $L1_0$-ordered CoPt structure has attracted researchers' interests due to its high magnetocrystalline anisotropy, large coercivity and high thermal stability, which make it promising candidate for the emerging spintronic devices and ultrahigh density recording media. On one hand, the layered $L1_0$ structure can be used for perpendicular spin valves, which are the core elements in magnetic sensors, hard disk read heads, and magnetic random access memories (MRAM). On the other hand, $L1_0$ granular films can be used for the heat-assisted magnetic recording media (HAMR), which is the most promising recording media in the next 10 years. In order to fabricate $L1_0$-CoPt, MgO single crystal substrates were generally used for the epitaxial growth of $L1_0$-CoPt. However, high cost, hygroscopic nature and poor mechanical properties made MgO not suitable for the practical application. At present, glass and silicon substrates are often used with the deposition of MgO seed layer for the epitaxial growth of $L1_0$-CoPt. Still, MgO seed layer is not preferred for the industrial application because of its low deposition rate and particle contamination on the media surface. Furthermore, MgO has a small surface energy ($1.1J/m^2$) which can result in a large contact angle between CoPt and MgO, and not favorable for the epitaxial growth of CoPt. On the other hand, TiN is a ceramic material but owns high electrical conductivity and excellent diffusion barring property, which is widely used as conductive barrier in microelectrical devices. Moreover, TiN has a larger surface energy ($1.28J/m^2$), which is more suitable for the epitaxial growth of $L1_0$-CoPt. Therefore, TiN with sodium chloride structure can be used as the seed layer for the epitaxial growth of $L1_0$-CoPt instead of MgO.

In the present work, the structure and Magnetic properties of CoPt/TiN thin films deposited on glass substrates by dc magnetron sputtering have been studied. The effect of annealing temperature, TiN layer thickness and N_2 flow rate ratio have been systematically investigated in both CoPt/TiN multilayer films and single layer films. (001) oriented $L1_0$-CoPt structure with perpendicular magnetic anisotropy (PMA) has been successfully obtained on glass substrates by controlling TiN crystal orientation and annealing temperature.

In order to obtain (001) oriented CoPt, (100) oriented TiN has to be fabricated. The orientation of TiN single layer has been investigated by changing N_2 flow rate ratio, substrate temperature and sputtering current. Through XRD measurement, the optimum N_2 flow rate ratio, substrate temperature and sputtering current have been obtained to fabricate highly (100) oriented TiN single layer films.

By using above deposition parameters, CoPt/TiN multilayer films were fabricated and PMA was obtained. It is found that by increasing the multilayer period, the crystallinity and crystal orientation of CoPt becomes better. As period increases, interface roughness also reduces. Alternate deposition of TiN and CoPt promotes the (001) orientation of CoPt, and due to which, magnetic anisotropy energy was drastically enhanced with period.

The effect of TiN layer thickness on the structure and magnetic properties of CoPt in CoPt/TiN multilayer films has been systematically investigated by changing TiN layer thickness. The optimum TiN thickness has been obtained to fabricate CoPt/TiN multilayer films with strongest PMA. When TiN layer thickness is too thin, multilayer films show magnetic isotropy due to the partially discontinuous condition of TiN layer. When TiN layer thickness is too thick, the interface roughness increases causing the large variants in CoPt layers, and leads to the reduction of PMA.

Perpendicular exchange-bias-like (EB-like) effect has been observed in CoPt/TiN multilayer films. It is found that TiN layer plays an important role for generating EB-like effect. TiN layer promotes the $L1_0$ transformation of the adjacent CoPt layer above it, but impedes the $L1_0$ transformation of the CoPt layer below it. This phenomenon generates the coexistence of the A1-CoPt phase and $L1_0$-CoPt phase in one CoPt layer sandwiched by two TiN layers after annealing. The coupling effect between A1 and $L1_0$-CoPt phases has been investigated, which is responsible for the perpendicular EB-like phenomenon.

$L1_0$-CoPt single layer films have been fabricated by using one TiN seed layer on glass substrates from the point of view of practical application. When TiN seed layer is above 30 nm, films show large perpendicular coercivity and narrow opening-up of in-plane hysteresis loops. Furthermore, by controlling N_2 flow rate ratio during the deposition of CoPt, $L1_0$-CoPt grain size can be reduced and perpendicular cocercivity can be further enhanced without enlarging the opening-up of the in-plane hysteresis loop. Since only Ar gas was used for $L1_0$-CoPt or FePt granular films deposition in most previous reported studies, our study can be a good method for fabricating $L1_0$-CoPt or FePt granular films with better magnetic properties.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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