論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
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論 文 要 旨
THESIS SUMMARY

系・コース： Department of, Graduate major in	Materials 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 (Engineering) Doctor of
学生氏名： Student's Name	Petrus Caesario	指導教員（主）： Academic Supervisor(main)	Ji Shi
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This thesis has described the study of the magnetic properties and microstructure of CoPt/TiN thin films deposited on glass and single crystal MgO (001) substrates under Nitrogen and Argon gas flow ratio. The experiments involve systematically varying the Nitrogen gas flow ratio, annealing temperature, and CoPt thickness to study their effects in both CoPt/TiN bilayer films and CoPt/TiN/CoPt trilayer films.

Ordering transformation in CoPt films have been achieved at a lower temperature and at a higher level of ordering parameter by controlling the annealing temperature and the Nitrogen gas flow ratio during the deposition. By standardizing the deposition of the CoPt films, the underlying effect of Nitrogen incorporation during the deposition on the ordering temperature of CoPt is studied by depositing the CoPt/TiN layer on MgO substrate. It is observed that the TiN under layer plays a huge part in determining the nature of nitrogen incorporation inside the CoPt film. Without TiN under layer, the CoPt grows coherently on top of the single crystal MgO substrate. However the larger lattice parameter of the MgO induces a huge strain on the CoPt layer. The tensile strain that was introduced is beneficial for the L10-CoPt formation due to two reasons. The first one is that the as-deposited A1-CoPt will have its lattice size more similar to L10-CoPt due to in-plane tensile strain. The second one is due to the rotation of the L10-CoPt c-axis towards the perpendicular direction during the post-annealing process. The addition of Nitrogen gas flow during the deposition will worsen the magnetic properties mainly due to the relaxation of said tensile strain in the CoPt film. The Nitrogen atoms will be incorporated inside the thin film, enhancing the lattice parameter and reducing the lattice mismatch between the two film which is the main source of the tensile strain energy inside the film. For samples deposited on MgO with TiN intermediate layer, the growth method is mostly incoherent and the tensile strain would be non existent inside the CoPt film. However, in this case the introduction of Nitrogen gas flow during the deposition does increase the L10-CoPt ordering transformation during the post-deposition annealing process. This is due to the formation of superabundant vacancies due to incorporation of Nitrogen atoms inside the CoPt lattice. The bonds between Nitrogen atoms and vacancies will lower the total formation energy of new vacancies inside the lattice and hence, more vacancies are formed in CoPt lattice with Nitrogen compared to normal CoPt lattice. This lattice will improve the diffusivity of Co and Pt atoms and thus it would be easier for the A1-CoPt to transform into L10-CoPt.

The effect of CoPt thickness when deposited on MgO single crystal substrate with TiN under layer has also been investigated in this thesis. It has been observed in the previous chapter that the growth of CoPt on MgO single crystal substrate with TiN under layer is of the incoherent growth. This could be explained from two phenomena. The first one is the low contact angle between the TiN and CoPt that let the CoPt grows as a continuous thin film instead of the island growth. The second one is the large lattice mismatch between TiN and CoPt that leads to a high strain energy inside the film. The thickness of CoPt was fixed at 10 nm while the TiN was fixed at 40 nm, and the orientation of both is the same in the (001) direction. Thus, it could be assumed that the 10 nm of CoPt was too thick for the epitaxial growth to be sustained. The large thickness and the good wetting contact angle between CoPt and TiN will cause the CoPt film to grow incoherently to relax the tensile strain inside the film. When the thickness of CoPt is reduced to 2.5 nm, it is more possible for the CoPt to sustain the coherent growth on top of the TiN layer. This coherent growth leads to tensile strain inside the CoPt layer and the A1-CoPt lattice will be strained in the in-plane direction such that the dimensions are similar to that of the L10-CoPt lattice. The formation of face centered tetragonal disordered lattice is observed to be sufficient to break the symmetry of the lattice and a magnetocrystalline anisotropy could be obtained from the disordered lattice.

In the last chapter a method of using the same material in order to ease the writability of the hard CoPt phase has been systematically studied by depositing a magnetically soft layer of CoPt on top of a magnetically hard CoPt layer obtained from the first chapter. Finally, the addition of an intermediate TiN layer has been proven to be able to tune the exchange coupling energy between the hard/soft CoPt layer. When a 1 nm thick TiN intermediate layer is inserted between the hard/soft(2.5 nm) CoPt layer, the exchange coupling energy is reduced to 0.57 emu/cm^2 and the switching field is reduced to around 3.5 kOe. Since only CoPt films are used as the base of the magnetic thin film, simple equipment is capable of reproducing our study, and this could be a good method to manufacture CoPt films for future high density magnetic recording media.

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).