UA13

Magnetic Properties and Growth Mechanism of Ultrathin Co Films on Si(111)- 7×7 Surface

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Recently, the combination of magnetic matter with semiconductor has drawn much attention because this field involves abundant science and potential applications in the development of ultrahigh density media. [1-2] In the past decades, magnetic and interfacial properties of ultrathin Co films grown on the Si surface have been investigated. [3] However, the detailed growth mechanism and magnetic properties of ultrathin Co/Si(111) films are still missing. Therefore, magnetic properties and growth mechanism of ultrathin Co films grown on Si(111)-7×7 surface have been studied by using both surface magneto-optic Kerr effect (SMOKE) and scanning tunneling microscopy (STM), respectively. STM results show that the existence of three dimensional islands in x ML Co/Si(111) ultrathin film at room temperature without annealing has been observed with Stranski-Krastanow (SK) growth mode. Due to formation of $CoSi_2$ layer, no magnetic signal could be detected by SMOKE for 1-4 ML Codeposited on Si(111) surface. Because of rougher surface, both longitudinal and perpendicular magnetic anisotropy configuration appear for 5-10 ML Co/Si(111) films. When the Co thickness is increased to 11 ML, only longitudinal anisotropy configuration exists, which might result from the contribution to the volume anisotropy. Furthermore, in-plane coercivity increases with Co coverage because of enhancement of ferromagnetic coupling with Co thickness, out-of-plane coercivity increases with Co coverage due to the increment of demagnetized field, induced by rougher Co surface.

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UA14

Optical Properties of Nanostructure $(In_{15}Sb_{85})_{100-x}Zn_x$ Thin Films

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Doped Sb-based materials have been widely used for optical phase change media [1]. Recently, due to the requirement of high speed optical disc, $In_{15}Sb_{85}$ recording film which had crystallization rate lower than 6 ns was proposed [2]. However, it has bad stability at amorphous state. In this work, Zn is doped in the $In_{15}Sb_{85}$ optical recording film to increase its thermal stability.

The $(In_{15}Sb_{85})_{100-x}Zn_x$ films (x = 0~13.7) with 20 nm thickness were deposited on nature oxidized Si wafer at room temperature by dc co-sputtering of In, Sb, and Zn targets. Thermal analysis indicates the phase transformation temperature of $(In_{15}Sb_{85})_{100-x}Zn_x$ films with x = 0, 6.2, 9.1, 13.7 are about 192.5 °C, 195.5 °C, 202.2 °C, and 212.3 °C, respectively. Kissinger's method [3] was used to evaluated the activation energy. Figure 1 shows the activation energy as a function of Zn content in $(In_{15}Sb_{85})_{100-x}Zn_x$ films. It is found that activation energies of $(In_{15}Sb_{85})_{100-x}Zn_x$ films with x = 0, 6.2, 9.1, 13.7 are about 2.18 eV, 2.267 eV, 2.719 eV, and 3.062 eV, respectively. This indicates that the thermal stability of amorphous state is increased with Zn content. The relationships between reflectivity and optical contrast of the $(In_{15}Sb_{85})_{100-x}Zn_x$ films at various wavelengths (λ) are shown in Figure 2. It is found that the optical contrasts of the films with x = 0~6.2 at λ= 405 nm and 650 nm are all larger than 15%, these films are suitable for optical recording media application.

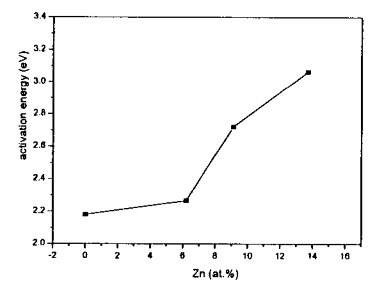

Fig. 1. Relationship between the activation energy and Zn content of the $(In_{15}Sb_{85})_{100-x}Zn_x$ film.

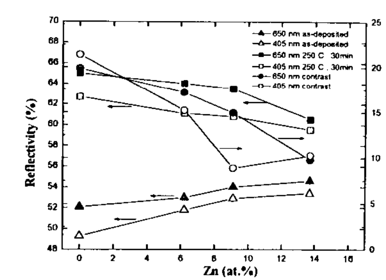

Fig. 2. Relationships among laser wavelength, reflectivity, and optical contrast of the $(In_{15}Sb_{85})_{100-x}Zn_x$ films before and after annealing at 250°C.

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