Optical recording characteristics of tin nitride thin films prepared by an atmospheric pressure chemical vapor deposition

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Recently, metal nitride materials have been gathering great interest from the viewpoint of their application to optical devices as well as electronic devices because they have appropriate wide band-gap characteristics. Among these, tin nitride is one of the IV-V compounds and has been scarcely studied. Only two reports were found in very early literature. In a previous paper, we reported that tin nitride films can be grown successfully on a glass substrate by an atmospheric pressure halide chemical vapor deposition (AP-HCVD).\textsuperscript{1,2} In this study, we reported the optical recording characteristics of tin nitride film.

Figure 1 shows the XRD pattern of the as-deposited thin film prepared by the AP-HCVD technique, along with that of the film annealed at 973 K. As is seen in Fig.1 (a), sharp lines are observed at \(2\theta = 17.0, 27.7, 32.7, 34.2\) and 57.2\textdegree. They assigned to the diffractions from (001), (100), (101), (002) and (200) of SnN\(_x\), with hexagonal structure, respectively, which indicates that the film consist of polycrystalline tin nitride with strong (002) plane texturing. This implies that they have the same structure as those prepared by sputtering method. The lattice constant \(a\) and \(c\) for the as-deposition tin nitride film were estimated to be 0.368 and 0.528 nm, respectively, also it is worth noting to point out that any trace of the peaks assigned to \(\beta\)-tin and tin oxide is not found. For the film annealed at 973 K in air, on the contrary, the diffraction peaks appear at 30.6, 32.0 and 44.9\textdegree (Fig.1 (b)). This is a typical pattern of \(\beta\)-tin, indicating that the tin nitride is decomposed to metallic tin.

In Figure 2, the reflectance spectrum of the as-deposited tin nitride film is shown together with that of the thermally annealed film. A comparison of both spectra indicates that thermal annealing increases the reflectance significantly. This implies that if any spots on the tin nitride film were annealed by laser beam, they would have different reflectance from their surroundings.

Figure 3 shows the AFM image of the laser-irradiated tin nitride thin film, in which the laser beam of 10.6 \(\mu\)m in diameter was shot on the film with a certain interval of distance. As is evident from Fig.3, one can see the humps lined on the surface. Also, it is found that little change observed for the laser-irradiated film after leaving it in 95 \% humidity at 333 K for 10 months. This means the tin nitride film is stable enough to be applied for optical recording media.

Consequently, it is found that the tin nitride thin films, prepared by the AP-HCVD technique, are decomposed to \(\beta\)-tin at 973 K in air. Similar reaction occurs in a limited area when it is heated by laser beam. Resulting humps appeared on the surface of tin nitride film was stable in an ambient atmosphere. As a result, it is presumed that the tin nitride films are feasible to apply for write-once recording media.

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**References**