# 4.7GB DVD-RAM Media Development and Transition from lab to Mass production

Wang Wei-Hsiang, Huang Min-Hui , Lu Tung-Kuei, Lin Ming-Huang ,
Tsai Hui-Fang, Chuang Jei-Ming, Chen Wei- His and Wang Shyh-Yeu

R&D Division, Media Business Group, Ritek Corporation,
No.42, Kuanfu N. Road, Hsin Chu Industrial Park, Taiwan 30316 R.O.C.
Phone:886-3-5985696 EXT:2073 FAX:886-3-5978482 E-mail wayne_wang@ritek.com.tw

## INTRODUCTION

The specification of 4.7 GB DVD-RAM media was developed in the fall of 1999 and commercialize in 2nd Q of 2000. For the high-speed recording, the layer design of 4.7GB DVD-RAM media become more complicated than the ever known phase changed optical media. A 7-layer structure had been proposed to satisfied the book specification(1). Comparing to the four-layer or five layer structure of CD-RW, DVD-RW and 2.6GB DVD-RAM, it is more difficult to get good yield and excellent disk performance in mass-production. Besides, 4.7GB DVD-RAM is available for computer data storage in the market. So the environmental stability is very important for 4.7GB DVD-RAM media in practical.

In this paper, we describe the development of 4.7GB DVD-RAM in our lab about thin film process and how to produce the good reliability disk in our factory.

## EXPERIMENTS

We use the Memex wave 2-5 sputtering machine to develop the 4.7GB DVD-RAM media in lab. It had five chamber including one RF chamber and four DC chambers. In the factory, we use Unaxis DVD-Sprinter to produce DVD-RAM media. It has eight chambers including five RF chambers and three DC chambers.

The optical constant ( refractive index n and extinction coefficient k ) was measured by n&K analyzer. The dynamic properties of 4.7GB DVD-RAM media were tested by Panasonic evaluator.

Fig1 Shows the cross-sectional view of experiment disks. Seven layers was deposited on a polycarbonate substrate of 0.6mm in thickness. The optical constant of GeNx thin film was controlled with nitrogen flow by reactive sputtering. Reliability of 4.7GB DVD-RAM media were tested under the environment of 90°C 80% RH for 24Hr. Then we measure the change of BER(byte error rate) of Archival and Shelf.

## RESULT AND DISCUSSION

Germanium alloy was widely used for the interface material in optical medium recently(2).It is considered that it can accerlate the crystallization process and prevent from sulfur diffusing into the recording layer(3). In this paper, we choose the GeCr alloy to be the interface material. Fig 2. shows the refractive index dependence on the nitrogen flow of GeCrNx thin film. . We can see the n value decreased when the nitrogen flow increased. Fig 3. shows the data Jitter dependence on the n valve. The 10 times data Jitter is almost the same versus the different refractive index. Fig 4. shows the cyclability dependence on refractive index n. We can see when the n valve of the sample is below 2.3 which had a better cyclability .We explained this phenomena because of hardness of thin film. When the nitrogen flow increased, the GeCrNx suppress the material flow more effectively and caused good cyclability.

Fig 5.(A) shows the generally process flow in the lab. Fig 5(B) shows the mass-production process flow in the factory. Usually, we initial the disk after bonding without annealing process. But in the factory, short cycle time and high throughput is requested during sputtering process. The high temperature resulted in the large stress in the disk and would cause damage in aging environment. We prefer to initialize the disk firstly and anneal the disk in a proper temperature for several hours. Finally, we finish the bonding process. Table 1 and Table 2 show the result of archival and Shelf testing. We can see the disk with annealing before bonding show the better result than traditional process. The stress of substrate is released during annealing including the stress come from the crystallization process of recording material. Sometimes, if the residual stress of disk is to large and it can not play in the drive after aging test.

## CONCLUSION

We successfully got a high quality 4.7GB DVD-RAM media by precisely sputtering control in GeCrNx thin film. When we transit the process form lab to factory, the disk was initialized and had a annealed process before bonding. Instead of traditional process, then we successful control the environmental stability of 4.7GB DVD-RAM disk.

## REFERENCE


1. H. Kitaura, E.Ohno, K. Nishiuch and N. Yamada, Proceedings of PCOS '99'89-94(1999)
2. N. Yamada, M. Otoba, K. Kawahara, N. Miyagawa and T. Matsunaga, "Phase Change Optical Disk Having a Nitride Interface Layer", Jpn. J. Appl. Phys. Part 1 (4B) , 2104-2110(1998).
3. M. Uno and N. Yamada "Acceleration of Crystallization Process by Nitride Interface Layer",Proc. Symp. on Phase-Change Optical Memory'98,85-90(1998)

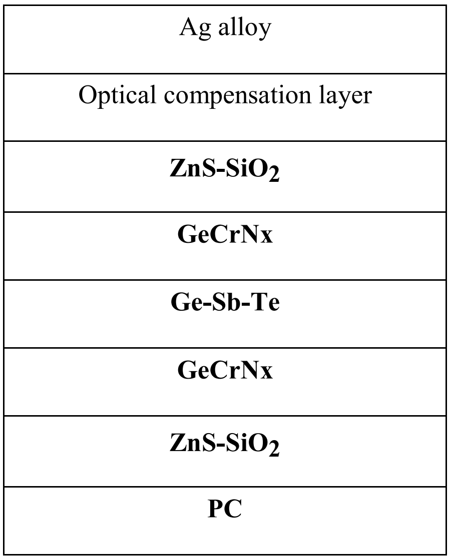



**FIG. 1 CROSS-SECTIONAL VIEW OF THE EXPERIMENTAL DISK STRUCTURE**

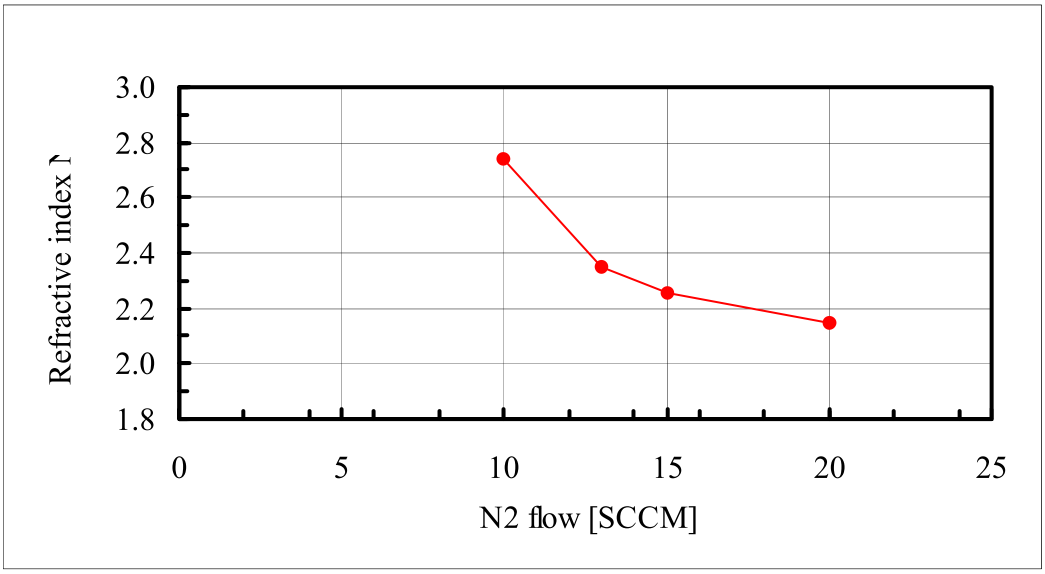



**FIG.2 THE REFRACTIVE INDEX DEPENDENCE ON THE NITROGEN FLOW OF GECRNX**

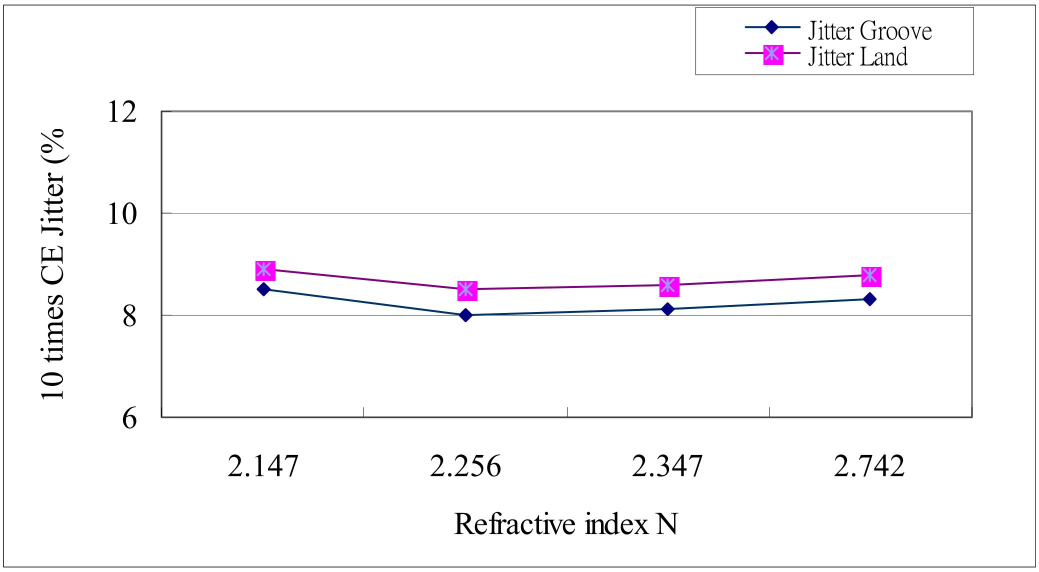



**FIG.3 THE 10 TIMES CE JITTER DEPENDENCE ON THE REFRACTIVE INDEX OF GECRNX**

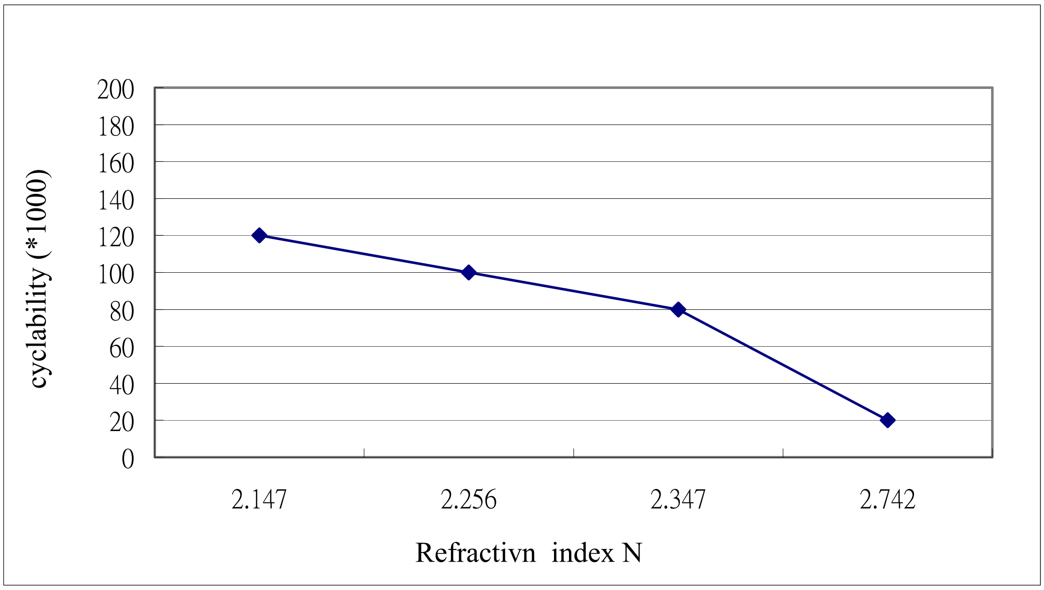
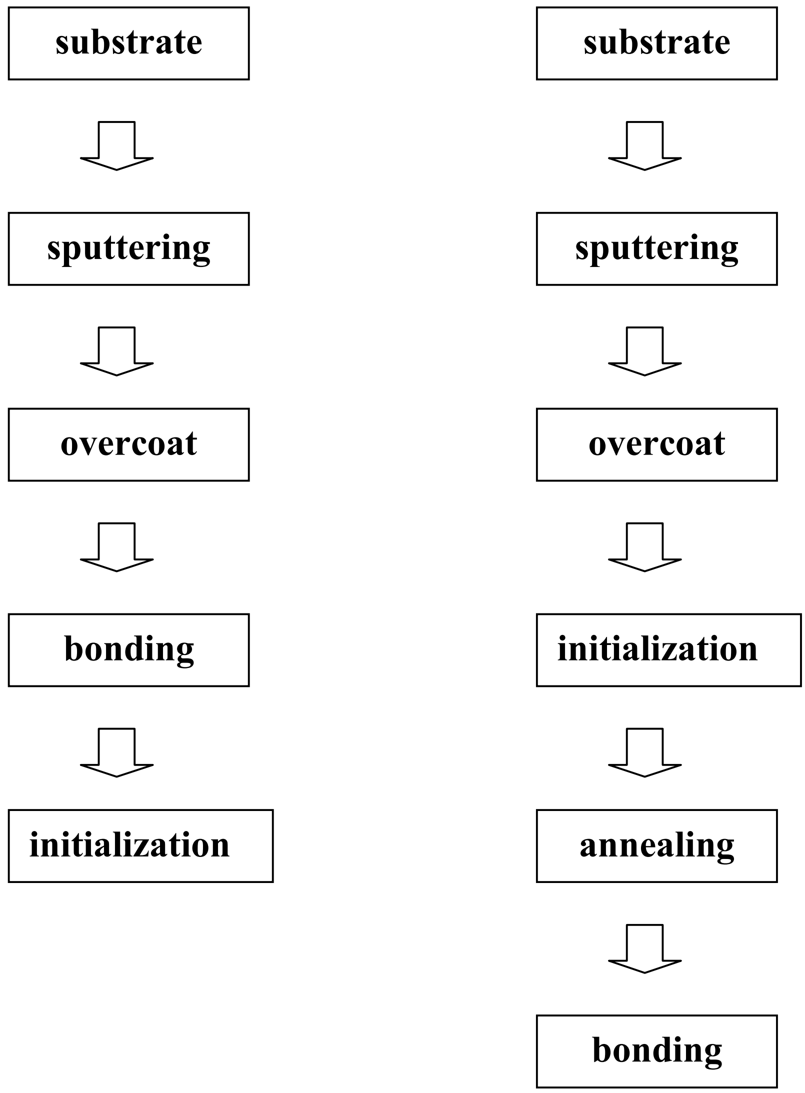



**FIG.4 THE CYCLABILITY DEPENDENCE ON THE REFRACTIVE INDEX OF GECRNX**




**(A) TRADITIONAL PROCESS** **(B) THE PROCESS IN MASS-PRODUCTION**

**FIG.5 THE PROCESS FLOW OF DISK MANUFACTURING**

**TABLE 1 THE ARCHIVAL TESTING RESULT OF 4.7GB DVD-RAM DISK**

| 編號 | Archival | | |
|---|---|---|---|
| | BER ( Before ) | BER ( After ) | A / B |
| A. sample without annealing | 5.68E-05 | 4.73E-04 | 8.33 |
| B. sample annealed before bonding | 7.64E-05 | 8.25E-05 | 1.12 |

**TABLE 2 THE SHELF TESTING RESULT OF 4.7GB DVD-RAM DISK**

| 編號 | Shelf | | |
|---|---|---|---|
| | BER ( Before ) | BER ( After ) | A / B |
| A. sample without annealing | 5.22E-05 | 2.49E-04 | 4.77 |
| B. sample annealed before bonding | 7.21E-05 | 8.87E-05 | 1.23 |