Trial for recording layer direct crystallization of Phase Change disc

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1. Introduction

Crystallizing process for phase change recording optical disc is done using the apparatus called " Initializer" with high power laser as the last process on media production.

This technology gives useful solution to product for all kinds of phase change recording media by using only tree parameters tuning, namely, total laser power, laser power density and laser scanning speed.

However this technology could not apply for synchronizing with one initializer for the typical production line speed so that some trials from material side are done called non-initialization process.

In this report, we show some possibility to realize another crystallizing method using In Chamber Crystallizer (ICC) as the new technology co-developed with W.Hofmann and G.Zardini, Pfeiffer Vacuum Systems Switzerland.

2. Development

Our concept when started this ICC trial in 1999 based on that initializing process of phase change disc should be done in same time and in same sputtering chamber during sputtering process of recording layer with high temperature environment.

And also we tried to show some possibility to avoid the harmful influence such as aggravation of media life time which is often occurred using a crystallization assisted layer for production process.

3. Experiments

The new designed optics for ICC installed to start this trial. The new optics for ICC loads 40w-laser making slow side 10-mm width laser spot and four lasers covered total radius of the disc.

- Trial#1

In the beginning, we started to confirm the possibility of actual recording layer crystallization in the vacuum chamber.

Ag-In-Sn-Te (AIST) based material was directly sputtered for polycarbonate substrate to crystallize using laser power and observed the changing of layer structure.

X-ray diffraction (XRD) pattern measurement results of the sample is shown in Fig.1.

The results show that AIST based target sputtered layer structure change from as Depo

State to crystalline.

We are using modified WAVE2-5 sputter machine from Pfeiffer Vacuum Systems for this experiment. The apparatus shape shows Fig.2.

- Trial#2

In the next stage, we made sandwich layer structure sample which consist from $ZnSSiO_2$ as lower protect layer, AIST and $ZnSSiO_2$ as upper protect layer, which crystallized same as trial#1 method. Fig.3 shows the sample structure of this experiment. In the beginning of this trial, we check the laser absorption late of each layer structure shown in Table.4 by optical simulation.

From the results of trial#1, we found too much laser power required obtaining the crystalline state than expected in the case of mono AIST layer structure. According the simulation results show the absorption rate of 10-nm thickness AIST layer has fewer than 10 percent. In case of sandwich layer structure has more over than 30 percent and also we expect to have some advantage of heating up effect from covered both thick protection layers? The simulation results show in Table.4.

Comparing the results to sandwich layer structure of this experiment and typical crystallizing method, we sputtered the reflection layer to the sample disc after crystallizing for testing area using conventional initializer in air atmosphere. Fig.5-1, -2 shows the results of crystallization method in two parts on one disc.

The results from ILC method are slightly lower than conventional method in comparison of reflective rate. The different of reflective rate result is caused by different laser power density between these two types of crystallizer.

- Trial #3

We also try to evaluate finding the possibility of new crystallizing method to another structure layer structure type, which shows in Fig.6, likes as next generation phase change disc.

We have no solution to evaluate the detail for this kind of disc except measurement of reflection rate in this moment. However we confirmed the function using another type of crystallizer, called ILC (ILC; In Line Crystallizer) and confirmed good results.

4. Conclusion

We confirmed the possibility using ICC method for crystalline process and obtain the good results. However there are some important issues for improvement to use industrial purpose.

1. The improvement of apparatus for obtaining more uniformed crystalline state.
2. The observation of material structure for high speed crystallizing.
3. The establishment of analyzing method to evaluate total performance of system.

References

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4. K. Hanaoka, M. Shinkai,K.Shibata,H.Miura and M.Harigaya ; Jpn.J.appl.Phys.'02 49th Spring Meeting , 29a-ZH-3 p1154 (Japanese)

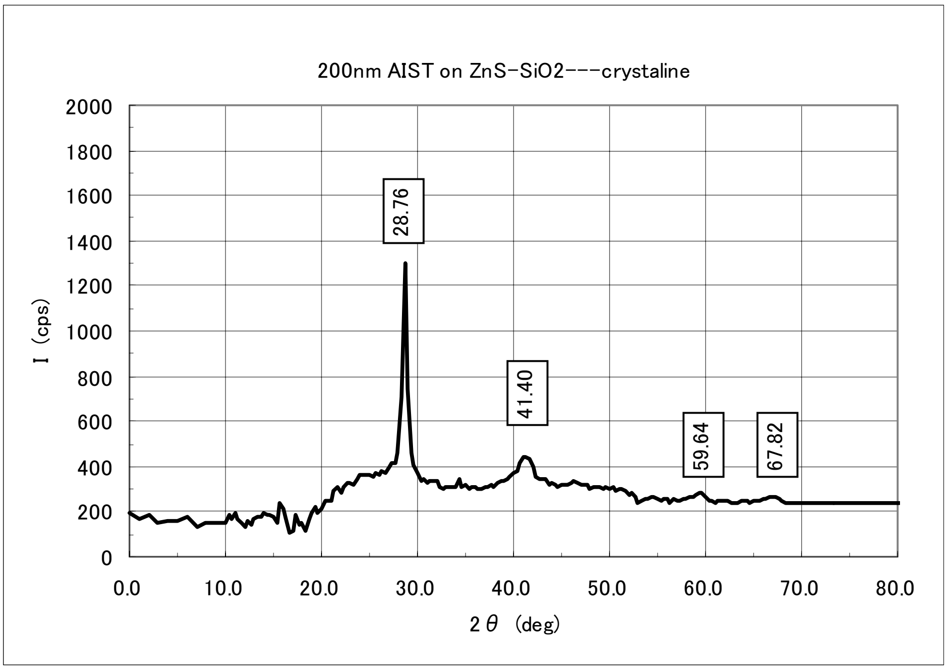

Fig.1　X-ray diffraction (XRD) pattern

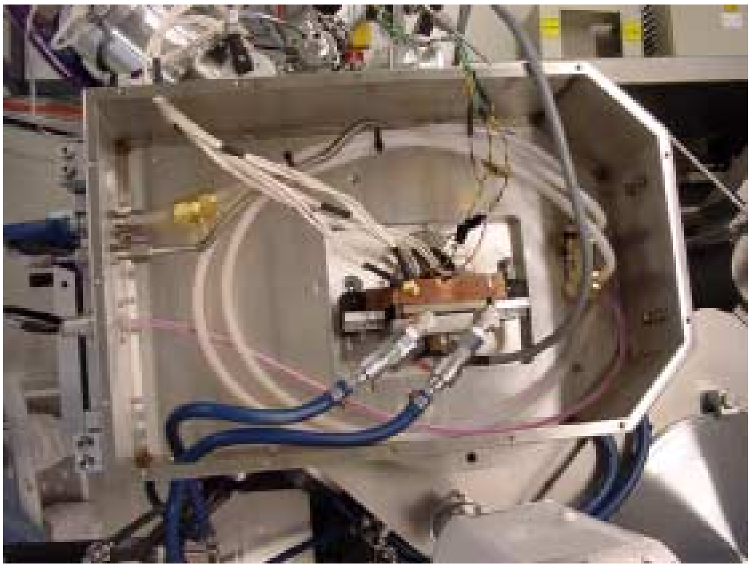

Fig.2　In Chamber Crystallizer

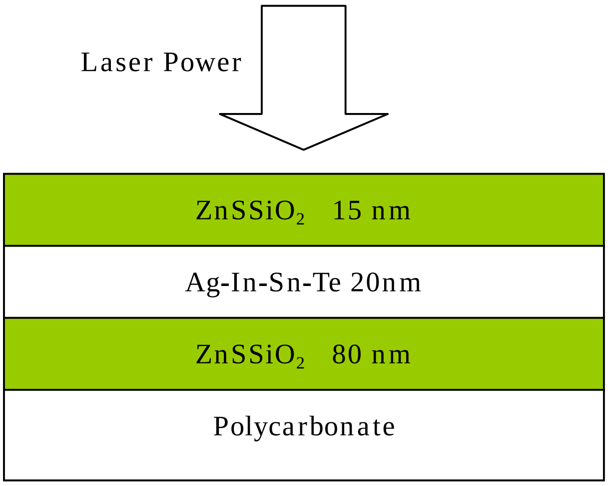

Fig.3 Layer structure for Trial#3

Layer structure	Reflection rate
AIST 10nm	5.8%
AIST 20nm	10.0%
$ZnSSiO_2$ 30nm+AIST 20nm+ $ZnSSiO_2$ 70nm	30.1%
$ZnSSiO_2$ 70nm+AIST 20nm+ $ZnSSiO_2$ 70nm	40.5%

Table. 4 Laser absorption rate

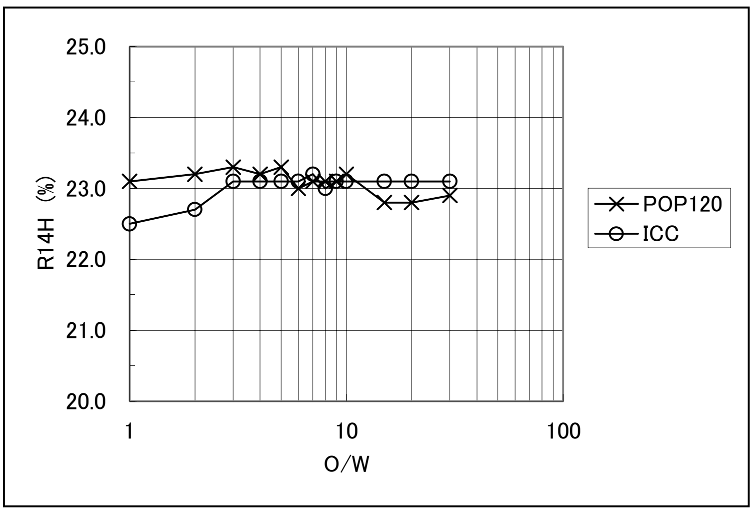

Fig. 5-1 Reflection rate

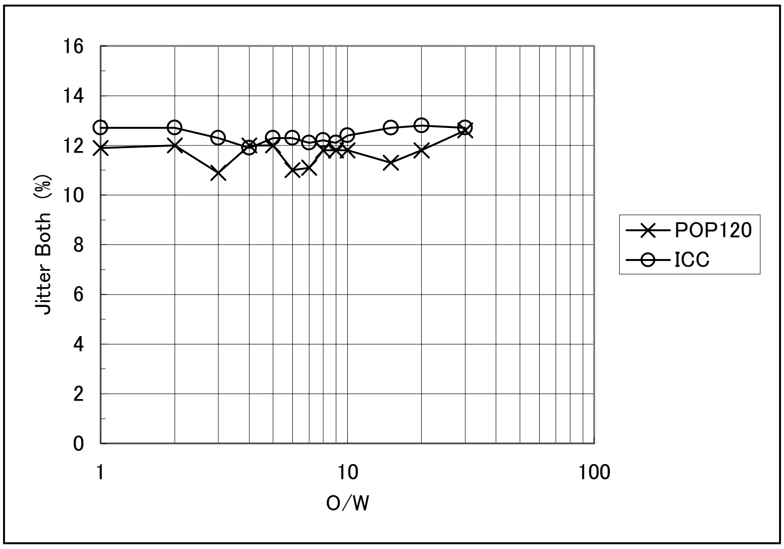

Fig. 5-2 Jitter Both

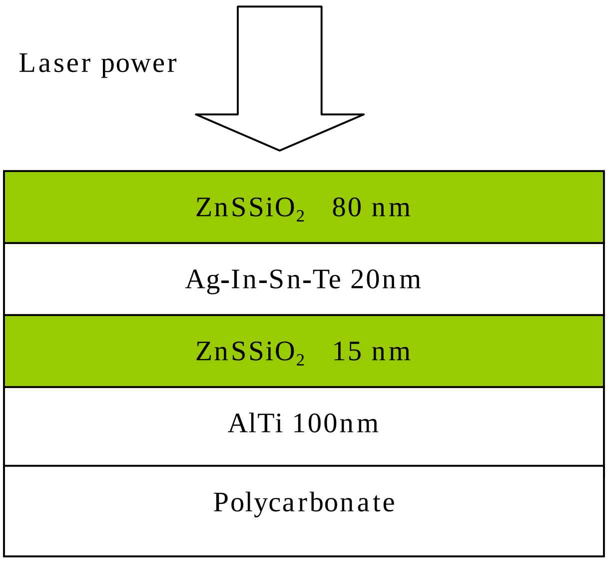

Fig. 6 Next generation type