CRYSTALLIZATION MECHANISM OF EUTECTIC MATERIALS OF PHASE CHANGE OPTICAL MEMORY

Masahiro Okuda[1)], Hirokazu Inaba[2)] ,and Shouji Usuda[3)]

[1)]Okuda Technical Office, 1-chome 2-27 Mozu Umemachi Sakai Osaka 591-8032,Japan
phone&fax:+81-72-257-9244 e-mail:okudaxma@skyblue.ocn.ne.jp
[2)]Osaka Prefecture University, 1-1 Gakuen-cho Sakai Osaka 599-8531,Japan
[3)]Osaka Prefectural College of Technology, 26-12 Saiwai-cho Neyagawa Osaka 572-8572,Japan

1. INTRODUCTION

A nonlinear heat conduction model for the dynamics of rapid crystallization in eutectic amorphous films has been investigated, which describe the propagation with constant velocity in an interface separating the crystalline and amorphous phase for AgInSbTe and $Ge(Sb_2Te_3)$+Sb materials. From these thermal analysis, it is clear that the crystallization is grown up in the boundary of crystalline-amorphous region of eutectic materials, which is different from the stoichiometric $Ge_2Sb_2Te_5$ media. Under favorable conditions, a self sustained (explosive) process results. Then, once crystallization has been initiated in the amorphous-crystalline region, the entire amorphous films has been crystallized.

2. CRYSTALLIZATION MECHANISM OF EUTECTIC MATERIALS

Crystallization of eutectic materials is reasonable for phase change optical disk, because it is well known that the smaller marks, the shorter the crystallization time. Therefore, we study a nonlinear heat conduction equation as shown in eq.(1). Also, analyzed structure in thermal conduction is shown in Fig.1. We assume that the amorphous-crystalline (a-c) interface velocity (growth rate) is an explicit function only the a-c boundary temperature Tx and $V(r,t)=A(T(r,t)-Tx)^2$. In eq(1), the first term on the right hand side gives the heat conduction through the layer; the second term results from the transformation to the moving frame; the third one crudely describes the heat loss to the substrate at temperature To. The fourth contribution is the source term due to the a-c boundary.

3. RESULTS AND DISCUSSION

As shown in Fig.2, it can be seen that during the forward motion of a-c boundary, a temperature pulse develops and propagates away from edge($r=r_0$) of temperature profile due to the laser. These temperature distribution in Fig.2 are investigated at the relation with latent heat q and laser intensity J. Figure 3 shows three dimensional relation with time t, distance r and temperature T.

4. CONCLUSION

A non-linear heat conduction model has been investigated for the eutectic materials of phase change optical memory. In the eutectic materials (AbInSbTe,$Ge(Sb_2Te_3)$+Sb), it is important that the relation with the propagation velocity of a-c interface and the latent heat liberated at the interface has been investigated.

REFERENCE

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$$\frac{\partial T(r,t)}{\partial t} = D\left[\frac{\partial^2 T(r,t)}{\partial r^2} + \frac{1}{r}\frac{\partial T(r,t)}{\partial r}\right] + \frac{J(r)}{cd} - \Gamma\left[T(r,t) - T_0\right] + qV(r,t)\delta(r - (r_0 - V(r,t)t))$$

where, T(r,t) :Temperature at r and t, D: thermal diffusivity, V(r,t): Interface velocity or Growth rate, δ: Delta function, q=L/c, L: Latent heat of crystallization, c: Specific heat per unit volume, d: thickness of the sample layer, $\Gamma\left[T(r,t) - T_0\right]$: Heat loss to the substrate at temperature T_0, J(r): Power density provided by laser.

Equation (1): Basic equation of crystallization.

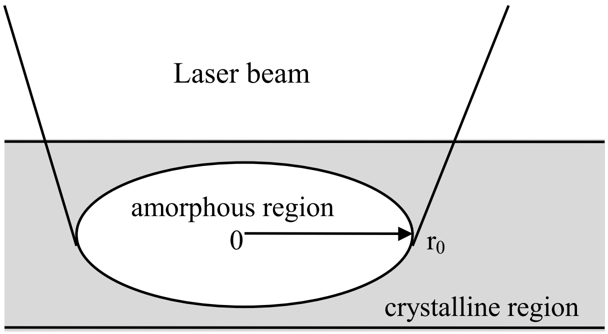

Figure 1. Crystallization in amorphous region.

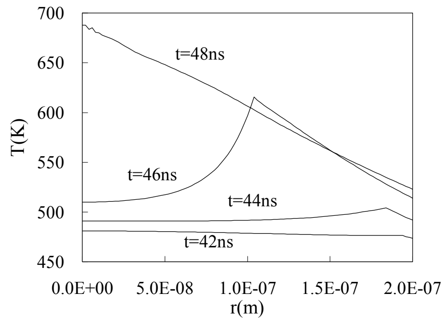

Figure 2. Temperature in crystalline region.

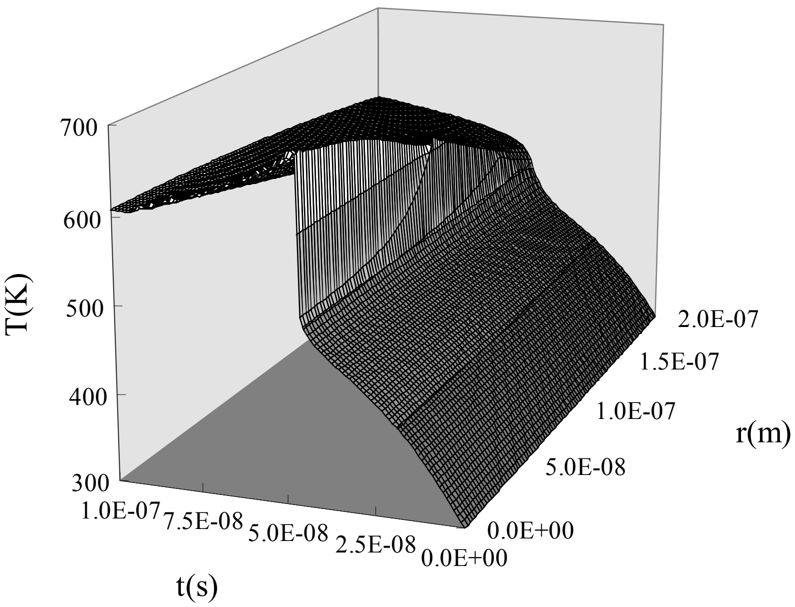

Figure 3. Temperature distribution of crystalline region.