Observation of Arcing in DC Magnetron Sputtering of AZO Target

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Abstract

Arcing phenomena was investigated in DC magnetron sputtering of AZO target. Arc count was found to depend on discharge power and working pressure. The arc most frequently occurred at 5mTorr. Velocity of cathode spot was larger for higher pressure.

Introduction

Mainstream of transparent conductive film has long been indium-doped tin oxide (ITO) in industry. However, the indium which is included in ITO is scarcity metal. Therefore, aluminum doped ZnO (AZO) attracts attention. Arcing (abnormal electrical discharge) to occur during deposition become a problem in sputtering. When the arcing occurs, target surface may melt and fly apart. It may change the thin film character.[1,2] Especially, the arcing is easy to occur on AZO target than ITO target. So we have observed cathode spot in DC magnetron sputtering with poisoning AZO target.

Experimental

Figure 1 shows the experimental setup. We used a poisoning AZO target (diameter 76mm) so that the arc may easily occur. We used a planar magnetron, in which the center magnetic pole is S, the outside circle magnetic pole is N. Erosion area is a range of radius 8~23mm. We have investigated the discharge power dependence of arc count as a parameter of working pressure using an arc counter. We took a movie of cathode spot with the high speed digital video camera (CASIO EX-FH20BK) that is able to take 1000 frames per second. We took a movie with 420 frames per second in the experiment. The movie was analyzed by Irfan View (free software).

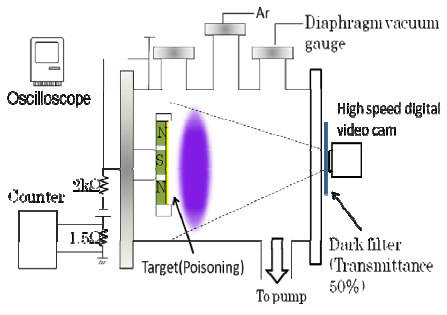

Fig1. Experimental setup

Results

We found that the cathode spot moves in the direction of **–JxB**. Figure 2 shows temporal change of arc count. The result indicates the arc count does not change so much with time. Figure 3 shows the discharge power dependence of arc count as a parameter of working pressure. The result indicates there are typical condition to cause arcing in power and working pressure. Figure 4 shows the discharge power dependence of arc velocity as a parameter of working pressure. The result indicates the arc velocity is larger for higher pressure.

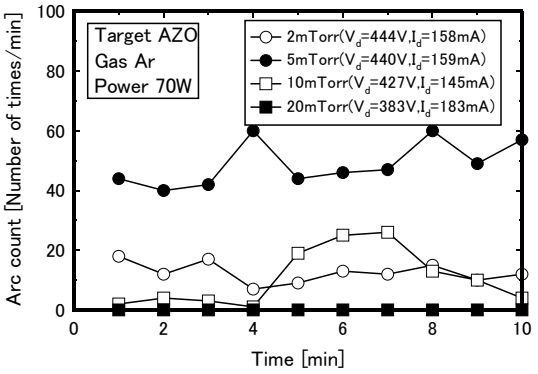

Fig2. Temporal change of arc count.

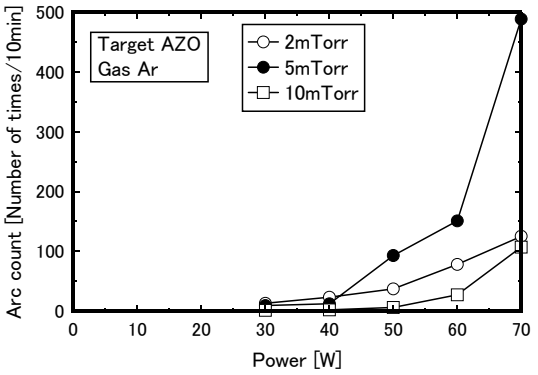

Fig3. Discharge power dependence of arc count as a parameter of working pressure.

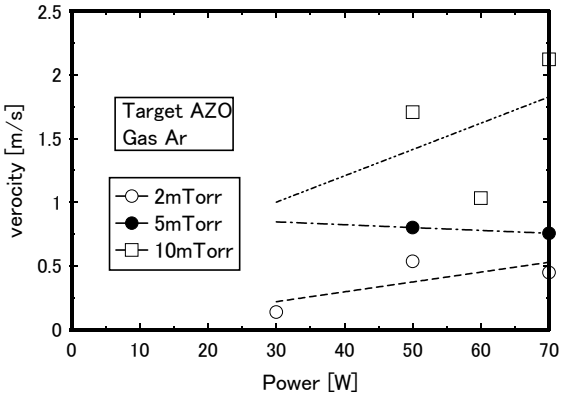

Fig4. Discharge power dependence of arc velocity as a parameter of working pressure.

Conclusions

The cathode spot moves in the direction of **–JxB**. Arc count does not change so much with time. Arc count depends on discharge power and working pressure. The arc velocity is larger for higher pressure.

References

[1] Andre Anders: Thin Solid Films 502 (2006) 22 – 28.

[2] Allen L Garner: Appl. Phys. Letters 92, 011505 (2008).