Influence of surface geometrical structures on the secondary electron emission coefficient (γ) of MgO protective layer

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ABSTRACT

Ion-induced secondary electron emission coefficient (γ) of the patterned MgO thin film with geometrical structures has been measured by γ - FIB(focused ion beam) system. The patterned MgO thin film with geometrical structures has been formed by the mask (mesh of ~ $10\mu m^2$) under electron beam evaporation method. It is found that the higher γ has been achieved by the patterned MgO thin film than the normal ones without patterning.

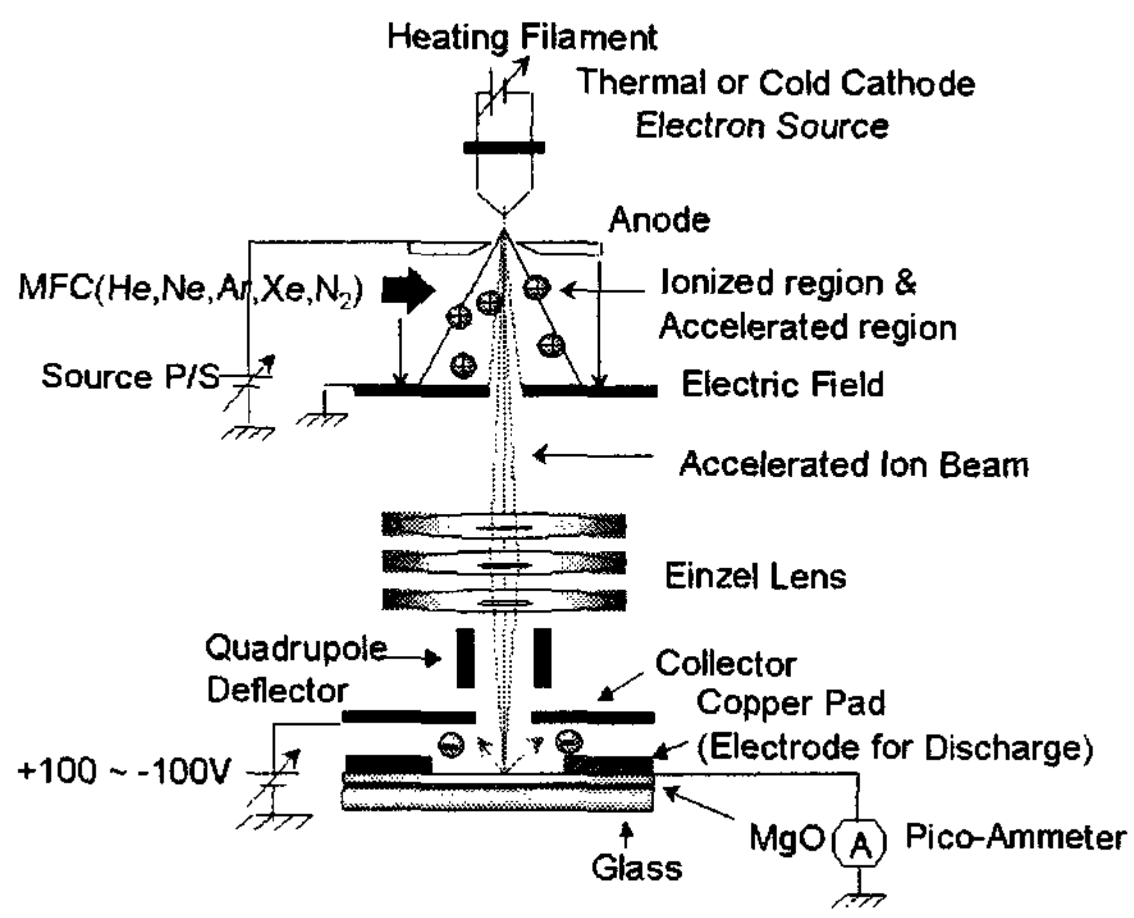


Figure 1. The schematic of γ-FIB (focused ion beam) system

INTRODUCTION

The characteristics of MgO films are very important for the development of recent AC-PDP.[1,2] The MgO protective film provides the required resistance to ion bombardment. Typically the layer is 7000 Å thick for the required lifetime of >20,000 hours. During operation the layer is gradually disappears. Owing to its high effective secondary ion emission value, it provides the lowest ignition voltages in a panel. That is to say, ion-induced secondary electron emission coefficient γ is one of characteristics of MgO film which correlates to the ignition voltage of PDPs.[3]. For achivements of higher value of γ, we suggest an alternative idea of MgO protective layer with large surface area in a pixel restriction.

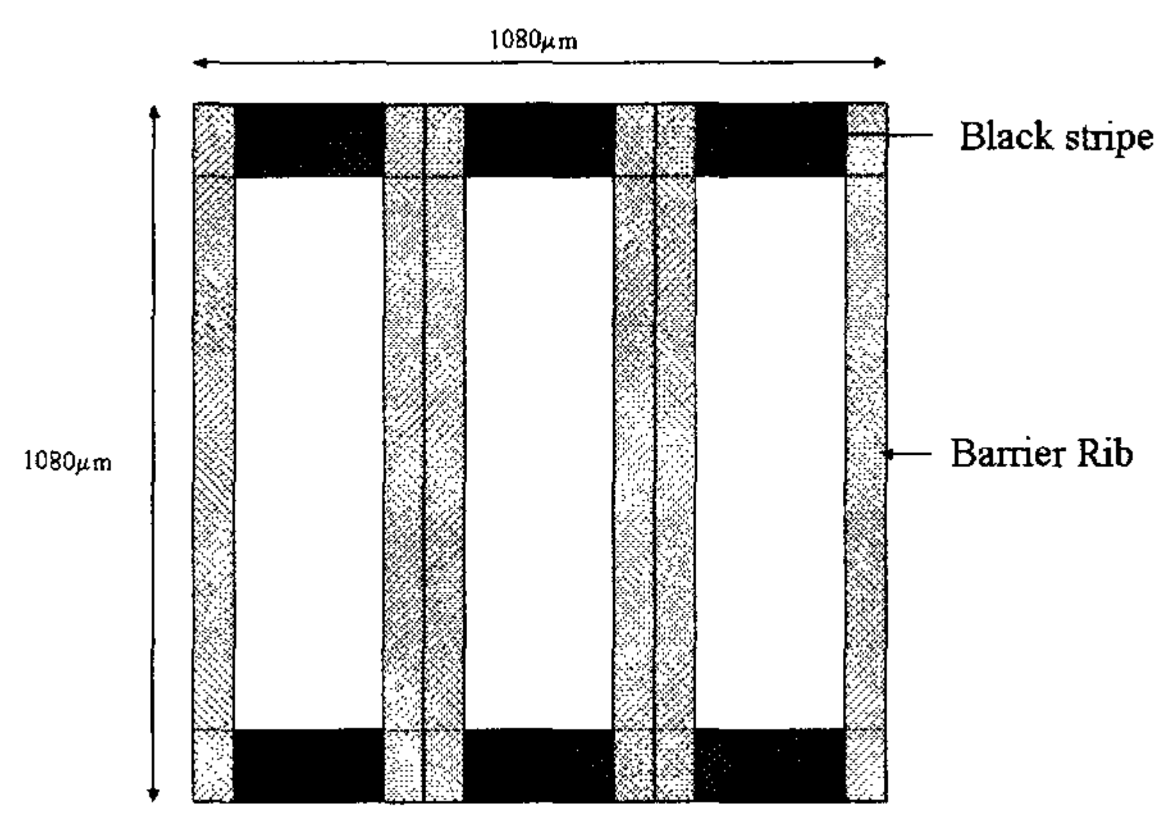


Figure 2. The schematic of standard pixel of the front panel

In this research, the γ of a mask-patterned MgO protective layer with large area and a normal one have been investigated by γ – FIB (focused ion beam) system.[4] Generally, a standard cell of AC-PDP has limited area in the basic structure because the size of the pixel is fixed by 1080×1080μm^2. But, essentially, the pixel has the effective area of 720× 840μm^2 since the standard PDP cell has barrier ribs and black stripes, as shown in Fig. 2. Here, we have investigated the relation between the area of the three dimensional mask-patterned MgO protective layer and the ion-induced secondary electron emission coefficient (γ) per unit area by adopting the ion beam of fixed diameter of 80μm. By changing the geometrical structure of MgO protective layer, the effective area emitting the ion-induced secondary electron per pixel can be increased. Therefore the higher ion-induced secondary electron emission coefficient γ can be achieved from the MgO protective layer per unit area by this idea.

Experimental Configuration

The three-dimensional mask-patterned MgO film has been deposited by electron beam evaporation method with mask of mesh, as shown in Fig.3. The thickness of MgO film is 1μm. There are two steps of deposition. First we make the MgO thin film to be in thickness of 5000Å. Second, the MgO film, 5000Å, with three dimensional structures has been deposited by the meshed mask of 30×30μm^2. The deposition rate is approximately 5~10Å/s in all of the process. The patterned MgO film structures are trapezoids and they have a height by 5000Å. Fig. 4 shows the cross section of mask-patterned MgO structures. These geometrical structures have an effect of increasing the effective area of MgO protective layer in pixel that is limited by the basic structure of PDP.

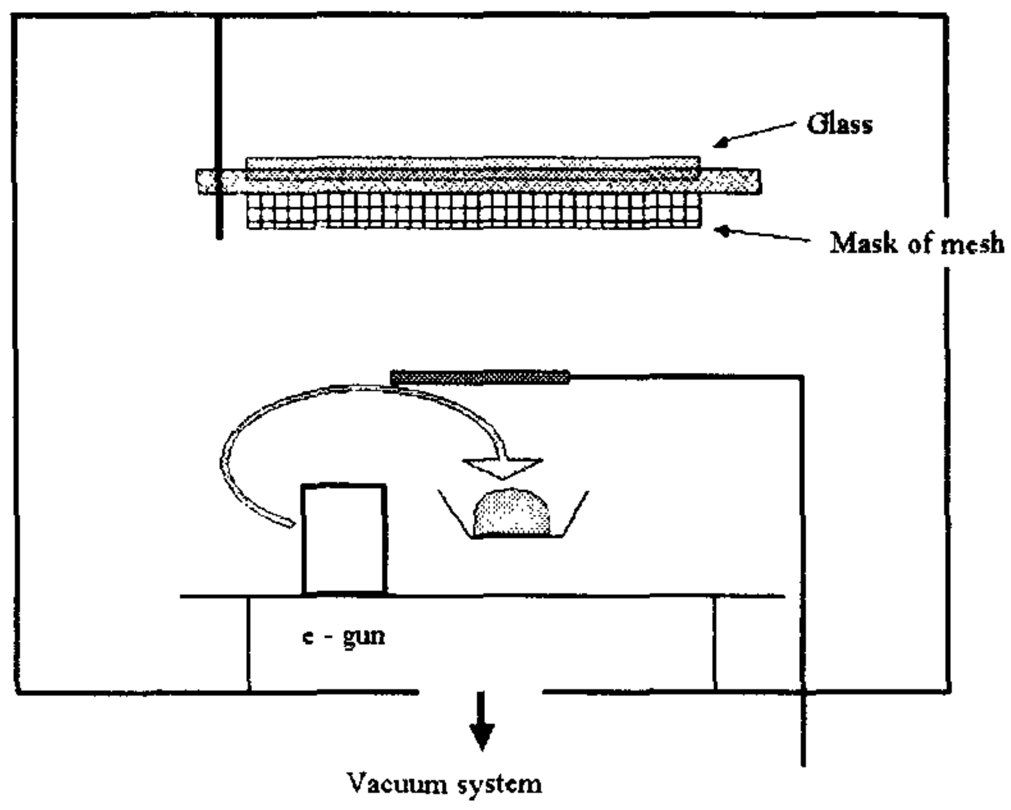
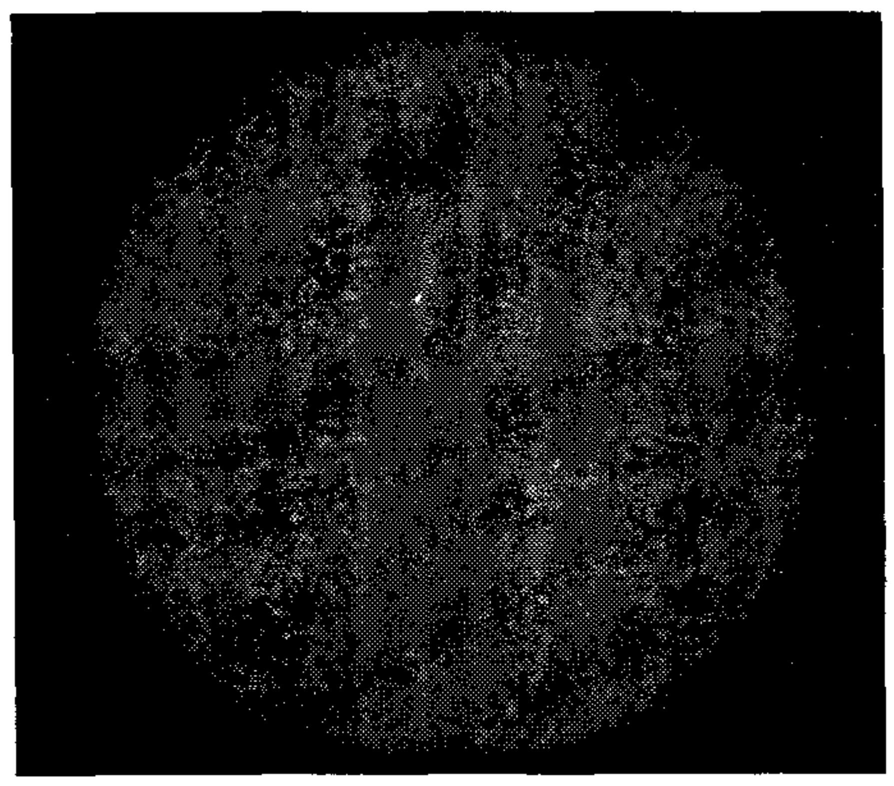


Figure 3. The schematic diagram of electron beam evaporation method with mask of mesh



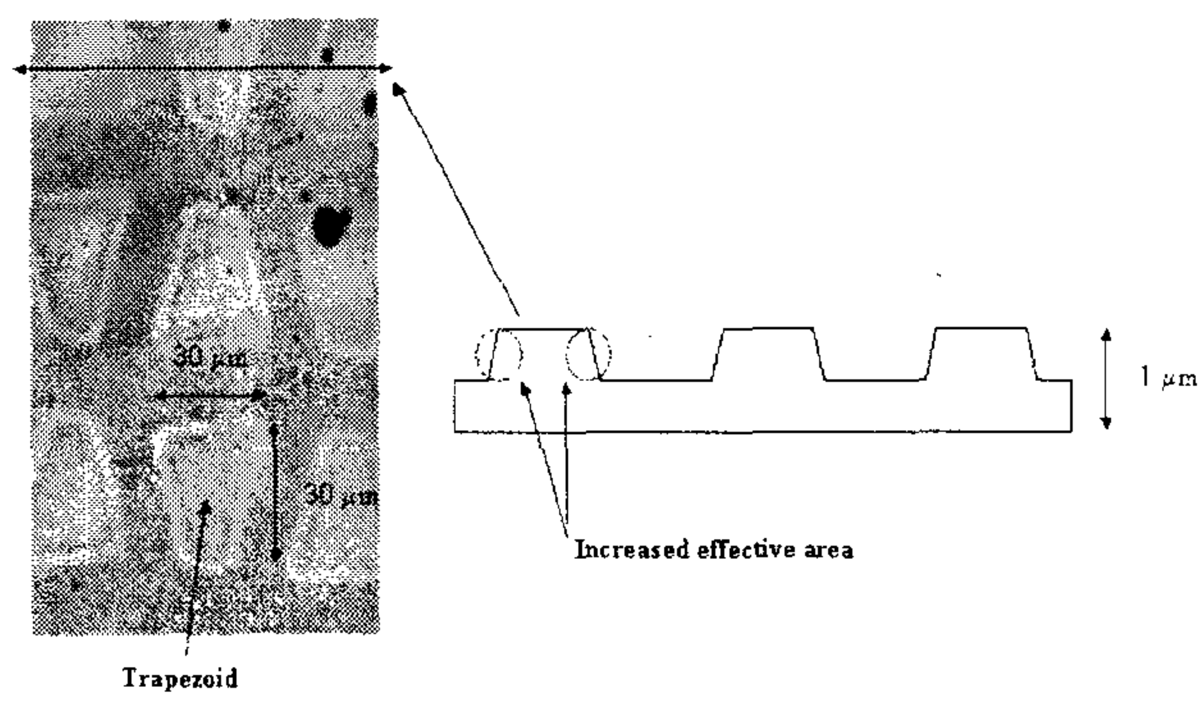


Figure 4. The picture of the geometrical structures in patterned MgO film

In this experiment, Ne^+ ion beams have been used for the measurement of ion-induced secondary electron emission coefficient γ, by varying its energy from 50eV to 200eV. The diameter of ion beam has been measured to be 80μm by the knife-edge method as shown in Fig.5. Therefore a cross-sectional area of ion beam is approximately 5000μm^2. There are about 3 trapezoids in this area of ion beam. So these three dimensional geometrical structures enlarge the effective area of MgO protective layer by about 180μm^2.

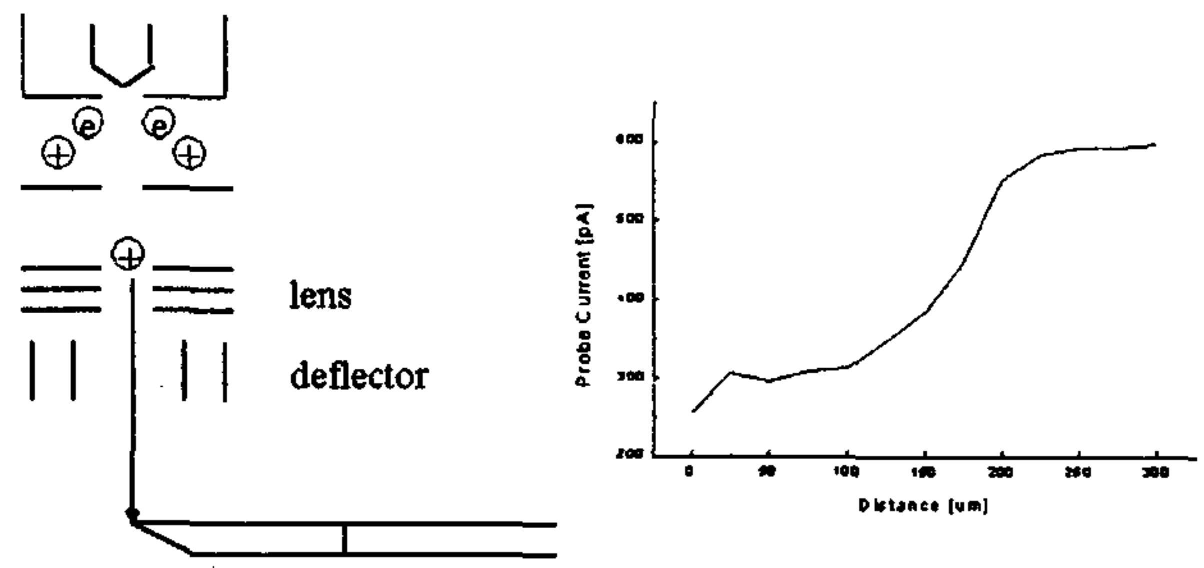


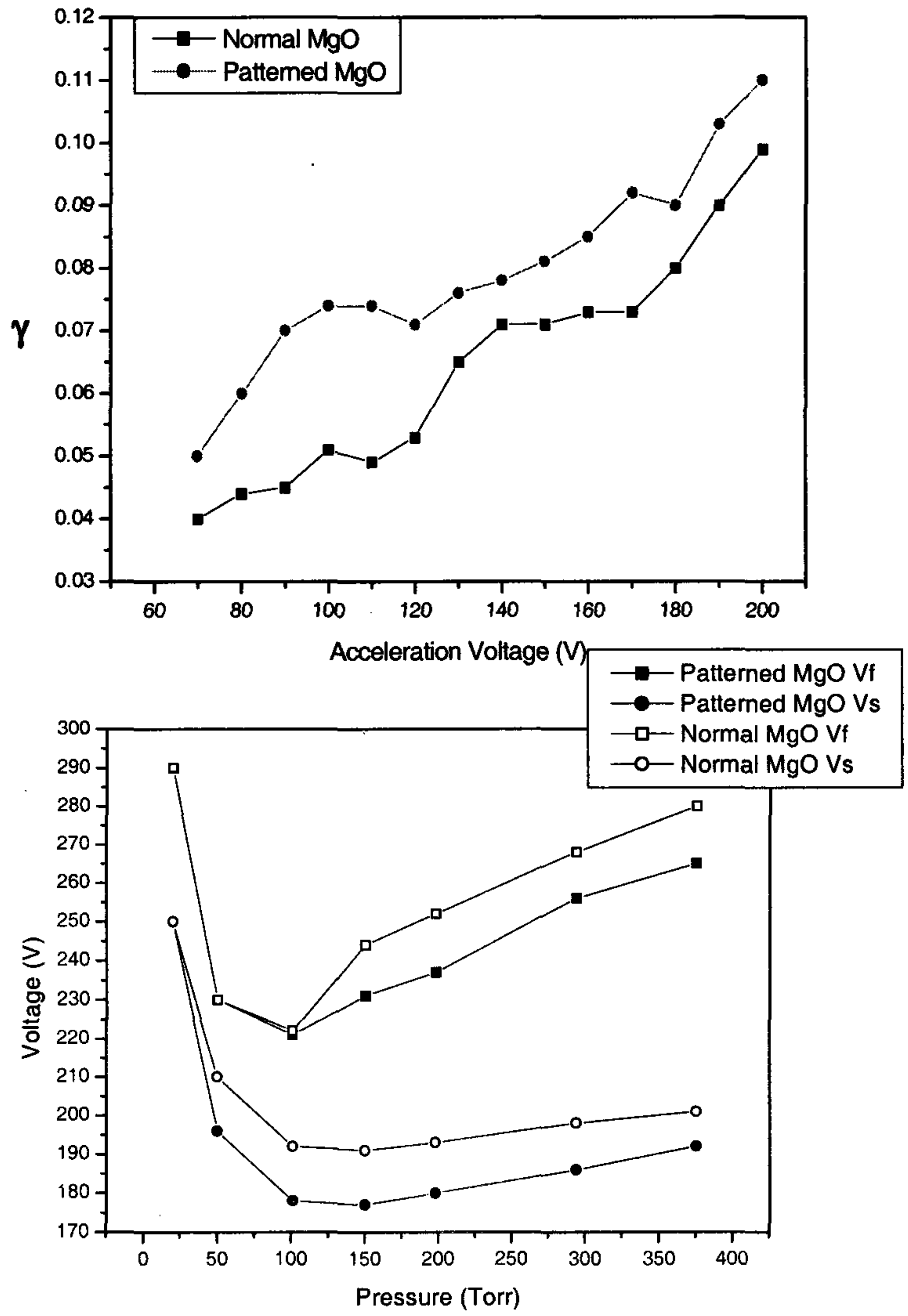
Figure 5. Knife-edge method for measurement of beam diameter.

Experimental Results and Discussions

Fig. 6 shows the ion-induced secondary electron emission coefficient (γ) .. for a three dimensional patterned MgO film and a normal one, which are characterized by solid squares and solid circles, respectively, versus ion accelerating voltages 70V up to 200V. The mask-patterned three dimensional MgO film has been found to have higher γ values than normal MgO one for above Ne^+ ion energy ranges. It is noted that the γ . of mask-patterned three dimensional MgO film is shown to be from 0.0547 up to 0.1144, while the normal one from 0.0481 to 0.099, respectively, under ion energy ranged from 70 eV to 200 eV throughout this experiment.

the experimental results is shown for the panel of the patterned MgO layer have lower ignition voltage(V_f) & sustain voltage(V_s) than the normal one without patterning. ignition voltage. Up to now, many researchers have conducted various attempt to get higher γ value of MgO protective layer used AC-PDP. For several years, major topic is a development of new material, i.e., CaO, SrO, BaO and CNT (Carbon Nanotube), in protective layer in

Figure 6. Experimental results



AC-PDP.[5][6] We suggest the new method of a three dimensional structures of MgO film. To get higher γ values, not only the new material is required but also this method for increasing the effective MgO protective layer in AC-PDP is strongly suggested, as presented by this experiment. But this research is in initial stage.

So we have to check some unknown parts; How long does this larger effective area can be hold down during operation? What's the problem in this method for fast or precise display in PDPs and others.

Acknowledgements

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Conclusion

For the first time, the MgO film with three dimensional structures has been manufactured by e-gun method with meshed mask. It is found that the ion-induced secondary electron emission coefficient (γ) of mask-patterned three dimensional MgO film has the higher γ values from 0.0547 up to 0.1144 versus Ne^+ ion energy ranged from 80eV to 200eV in this experiment, than the normal ones.

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