Slow Noble Ion – Induced Secondary Electron Emission Characteristics of MgO Layer.

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Abstract

We have measured the secondary electron emission yield γ_i from MgO films deposited on SiO_2/Si for low energy noble ions. A pulsed ion beam technique was employed in order to suppress the surface charging effect during the measurement. From the measurement of the ion – induced secondary electron emission coefficients γ_i for 5 noble ions with energies ranging from 50 eV to 225 eV, it was shown that, with increasing the kinetic energies of the incident ions, the γ_i increased

1. Introduction

Recently, ac-plasma display panels(ac-PDP)[1-3] have obtained lots of attention because of their potential application to a high definition television display due to their performance properties such as large flat display, high brightness, fast response and wide viewing angle. Magnesium Oxide(MgO) is one of the most crucial films as a protective layer for the operation of the ac-PDPs. MgO has dual roles, protecting the dielectric layer from erosion by the plasma within each cell and having a high secondary electron emission to reduce the operational voltage. The development of protecting materials of low firing voltage (with high γ_i) is important in order to develop a better plasma display. In this study, we characterized the measurement of the secondary electron emission from MgO for low kinetic energy noble gases by a pulsed ion beam method.

2. Experimental

The ion source system (Colutron Inc. model G-2-D) was adapted to deliver a focused mass-selected ion beam from the ion source to the target. The mass-filtered ion beam is chopped to a pulsed ion beam by applying a high voltage to the potential way the continuous beam goes. 1000 Å MgO films were e-beam evaporated onto SiO_2/Si substrate. The thickness of the films was monitored by ellipsometer and alpha-step. X-ray diffraction patterns were used to characterize the crystallinity and orientation of the MgO. The sample was heated radiatively to 350 °C by a tungsten filament to discharge the surface charging and remove water from the surface before the measurement.

3. Results and Discussion

The comparison of the secondary electron emission coefficients γ_i of 500 Å Au film on SiO_2 obtained by the pulsed ion beam (solid squares) and the continuous beam (solid circles) are shown in Fig. 1. Helium ions with kinetic energies ranging from 30 to 200 eV were used to characterize the secondary electron emission from 500 Å Au films sputter-formed on SiO_2. In case of metal layer, the secondary electron emission coefficients obtained by the two methods showed the same values because the surface charging does not occur when the Au layer exposed to the bombardment of the ions. With the good agreement in γ_i of Au layer, a new method of the pulsed ion beam was applied to dielectric layers. Figure 2 shows the dependence of γ_i on the ion - beam bombardment time, indicating decreasing γ_i while the time increasing. From the fig. 2, the secondary electron emission decreased 0.62 to 0.3 after the exposure to ion-bombardment for an hour. The decrease of γ_i may be due to some change of the surface atomic bonding structure as well as stoichiometry. Figure 3 showed the secondary electron emission coefficients from 1000 Å MgO grown on SiO_2/Si for five different noble ions with the kinetic energies ranging from 50 to 225 eV. As shown in figure 3, heavier ions yield smaller emission coefficients at a fixed kinetic energy. It is notable that, for the given ions, the secondary electron emission coefficients showed the dependence on the kinetic energy.

4. Summary

The secondary electron emission characteristics of MgO was investigated for five kinds of noble ions. It was clearly demonstrated that the secondary electron emission from MgO depends on the mass of the incident ions as well as the kinetic energy of the bombarding ions. The sputtering of the ions was found to have a considerable effect on the secondary electron emission from MgO films, showing the secondary electron emission coefficient decreased dramatically upon the bombardment time.

5. Acknowledgement

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6. References

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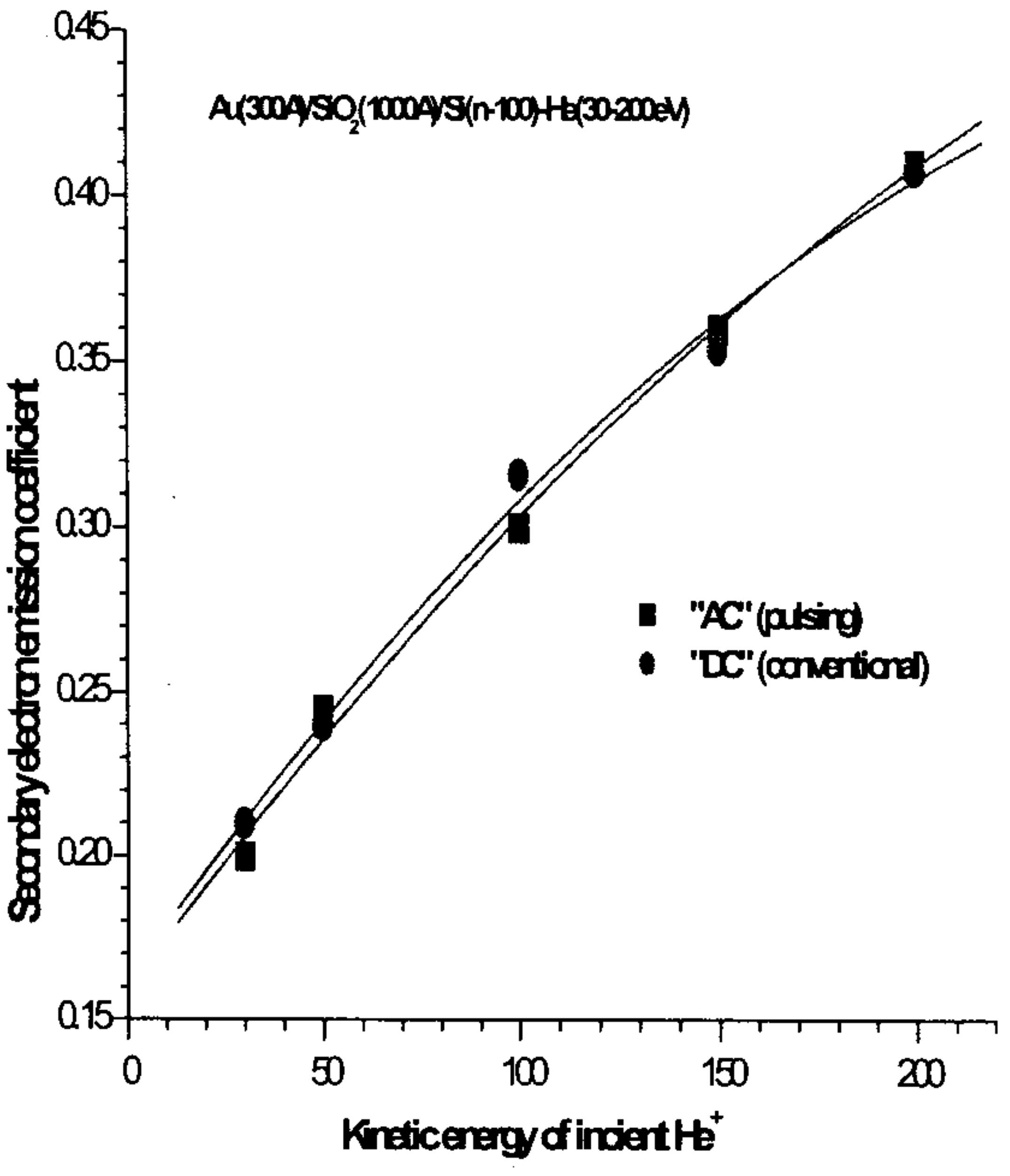

Figure 1.The comparison of the secondary electron emission coefficients of 500 Å Au for He$^+$.

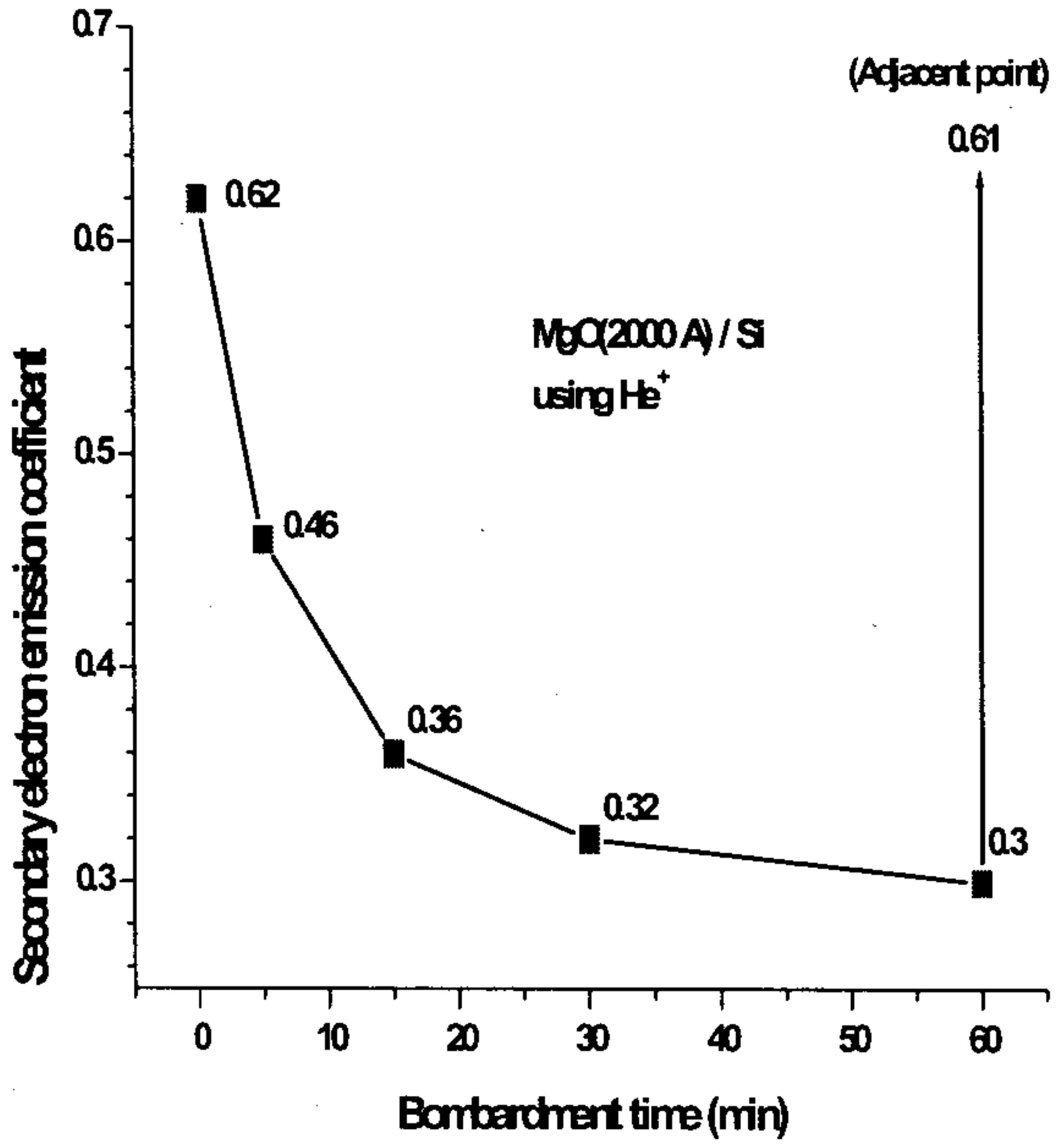

Figure 2. Sputtering effect on the secondary electron emission from MgO

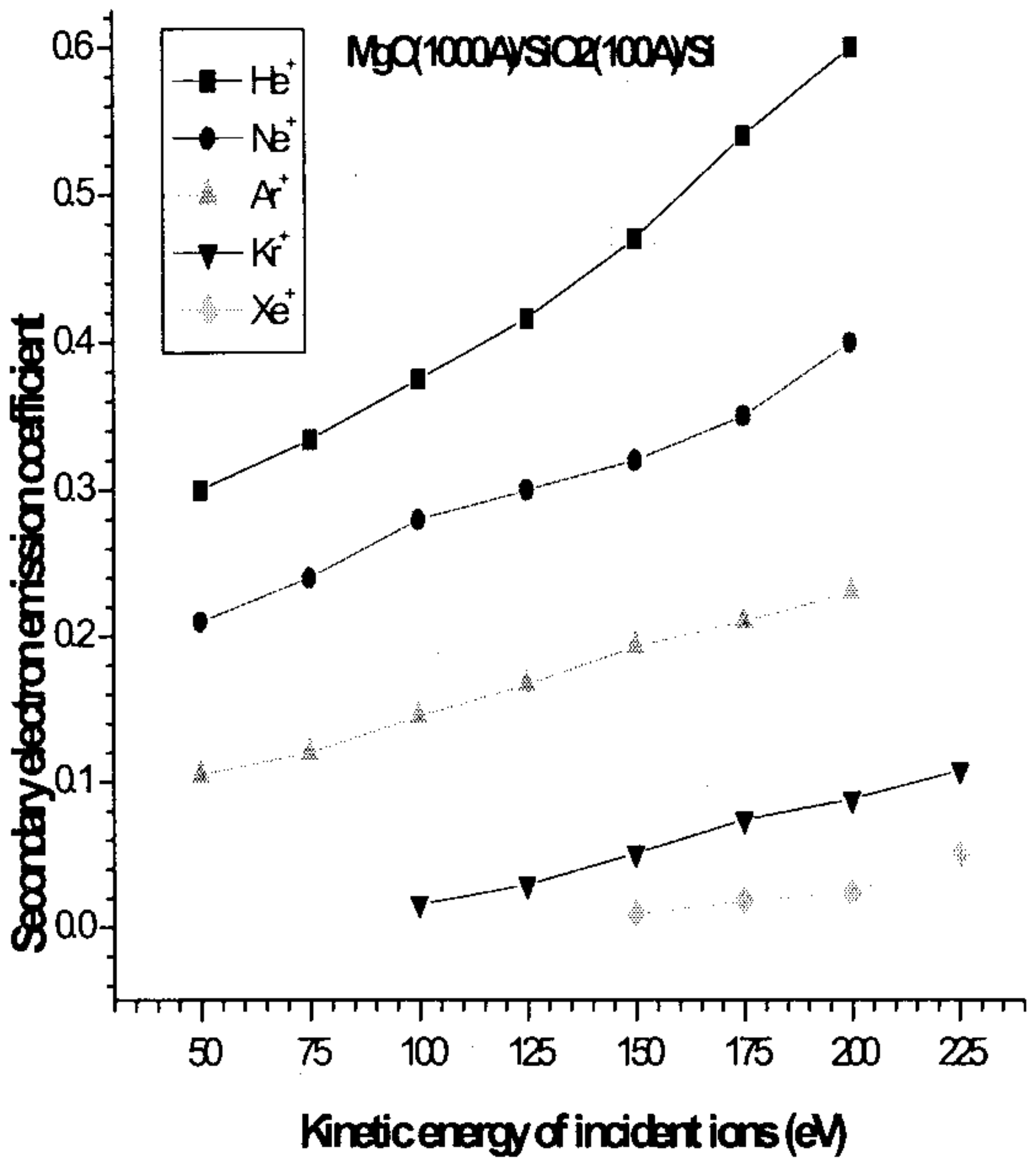

Figure 3.Secondary electron emission coefficients of MgO for five different noble ions