[S-07]

Measurement of ion-induced secondary electron emission coefficient of insulator films by pulsed ion beam method

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MgO film has been used as a protective dielectric layer for the electrodes in a PDP(plasma display panel) because of its high erosion resistance as well as the high secondary electron emission coefficient($\gamma$) under ion bombardment from the plasma. These are the required properties of a protective layer for a long lifetime and high luminous efficiency of PDP. If one can replace MgO with a dielectric material which has a higher $\gamma$, than MgO, the power efficiency can be greatly improved. However, no reliable $\gamma$ data for a wide variety of insulating materials are available yet because of the intrinsic difficulty associated with $\gamma$, measurement for insulator films due to the unavoidable surface-charging problem. Here we demonstrate that a pulsed ion beam technique is a viable solution to this problem, in which the low beam current enables one to measure $\gamma$, before the surface charge builds up to an appreciable level to suppress electron emission.

The $\gamma$'s of the metal surfaces, which suffer no surface charging problem, were measured for Mo(100), Si(100), and Mg film surfaces. The results coincided with those measured with a dc ion beam, thus confirming the reliability of the measurement scheme with a pulsed ion beam. The $\gamma$'s of the corresponding oxide films—MoO$_3$, MgO, SiO$_2$—were also measured using pulsed noble gas ion beams at ion energies ranging from 50 to 200eV. We found 1) increase in $\gamma$, upon oxidation and 2) a relatively large increase in $\gamma$, increasing ion energy. The results will be discussed in terms of the electron emission mechanism.