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

Jaewook Choi, Deok Hyeon Kim, Sohee Kim and Jihwa Lee
Department of Chemical Engineering, Seoul National University

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(γ_i) 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 γ_i than MgO, the power efficiency can be greatly improved. However, no reliable γ_i data for a wide variety of insulating materials are available yet because of the intrinsic difficulty associated with γ_i 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 γ_i before the surface charge builds up to an appreciable level to suppress electron emission.

The γ_i'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 γ_i'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 γ_i upon oxidation and 2) a relatively large increase in γ_i increasing ion energy. The results will be discussed in terms of the electron emission mechanism.