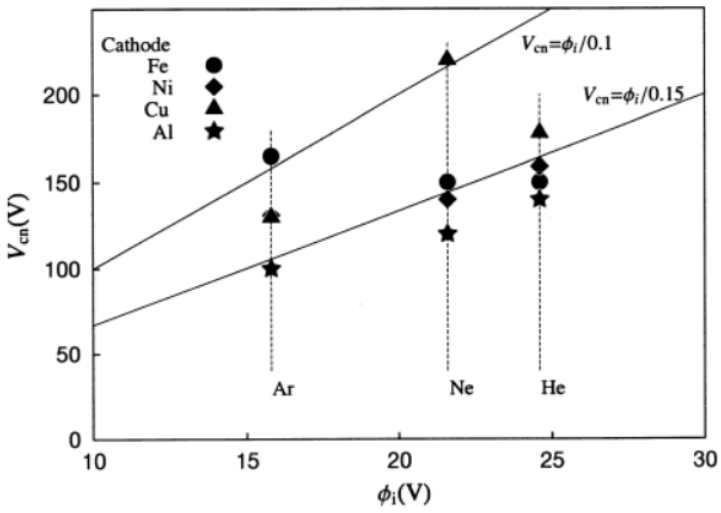
A Brief Comment on Property of Electron Yield (Gamma Process) in Glow Discharge Cathode Materials by Ion Bombardment

Mase.H

The secondary electron emission by ion bombardment is usually measured under the condition of the monoenergetic ion beam irradiation to the materials. Here we try to discuss the property of electron yield in the cathode materials considering the characteristics of normal glow cathode fall.

The normal glow cathode fall V_{CN} is the minimum potential drop that is required to sustain the glow discharge and V_{CN} is obtained from the equations of the yield of electrons by ion bombardment $J_e = \gamma_i J_i$ and the energy balance, $J_e V_{CN} = \phi_i J_i(1+\Delta_\varepsilon)$ that is the energy input and energy consumption for ion production. In this case, the electron beam accelerated by cathode fall is assumed to be trapped in the discharge space. Therefore the cathode fall V_{CN} is given by $V_{CN} = \phi_i(1+\Delta_\varepsilon)/\gamma_i$, where ϕ_i, Δ_ε and γ_i are the ionization potential of gases, the rate of other energy losses except ion generation and the electron yield by ion bombardment (gamma process) respectively [1, 2, 3].

If Δ_ε is much smaller than unity, the cathode fall is simply expressed as follows, $V_{CN} \sim \phi_i/\gamma_i$. The figure demonstrate the relationship between the normal glow cathode fall V_{CN} and the ionization potential of gases under the various cathode materials. The values of V_{CN} are used the experimantal results after Francis G 1956, The Glow Discharge at Low Pressure in Handbuch der Physik XXII (Springer-Verlag).



The figure shows that γ_i is in the range from 0.1 to 0.15 for the usually used cathode materials, Ni, Fe, Cu and Al. However the relationship of $V_{CN} \sim \phi_i / \gamma_i$ appears to be dominated by deffernt dependence in the combination of cathode material and incident ion species. In order to make a more correct evaluation of γ_i by the cathode fall V_{CN}, a detealed consideration of Δ_ε would be reqiured.

References:

[1]1987, Proc. XVIII ICPIG (Swansea) **4**,746
[2]1992, Double Layers and Other Nonlinear Potential Structures in Plasma ed. Schritwieser R W (World Scientific) 376
[3]2001, the Topical Lectures of XXXV ICPIG, Nagoya Japan