

Adsorption of residual gases on carbon nanotubes and their field emission properties

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Abstract : Carbon nanotubes (CNTs) have long been reported as an ideal material due to their excellent electrical conductivity and chemical and mechanical stability as well as their high aspect ratios for field emission devices. CNT emitters made by screen printing the organic binder-based CNT paste may act as a source to release gases inside a vacuum panel. These residual gases may cause a catastrophic damage by electrical arcing or ion bombardment to the vacuum microelectronic devices and may change their physical or electrical properties by adsorbing on the CNT emitter surface. In this study, we analyzed the composition of residual gases inside the vacuum-sealed panel by residual gas analyzer (RGA), investigating the effects of individual gases of different kinds at several pressures on the field emission characteristics of CNT emitters. The residual gases included H₂, CO, CO₂, N₂, CH₄, H₂O, C₂H₆, and Ar. Effect of residual gases on the field emission was studied by observing the variation of the pulse voltages with the duty ratio of 3.3% to keep the constant emission current of 28 μ A. Each gas species was introduced to a vacuum chamber up to three different pressures (5×10^{-7} , 5×10^{-6} , and 5×10^{-5} torr) each for 1 h while electron emission was continued. The three different pressure regions were separated by keeping a high vacuum of $\sim 10^{-8}$ torr for a 1 h. The emission was terminated 6 h after the third gas exposure was completed. Field emission characteristics under residual gases will be discussed in terms of their adsorption and desorption on the surface of CNTs and the resultant change of work function.

Key Words : carbon nanotube, field emission, residual gas analyze, adsorption, work function