Fabrication of Field Emitter Arrays by Transferring Filtered Carbon Nanotubes onto Conducting Substrates

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Abstract : Carbon nanotubes (CNTs) belong to an ideal material for field emitters because of their superior electrical, mechanical, and chemical properties together with unique geometric features. Several applications of CNTs to field emitters have been demonstrated in electron emission devices such as field emission display (FED), backlight unit (BLU), X-ray source, etc. In this study, we fabricated a CNT cathode by using filtration processes. First, an aqueous CNT solution was prepared by ultrasonically dispersing purified single-walled CNTs (SWCNTs) in deionized water with sodium dodecyl sulfate (SDS). The aqueous CNT
solution in a milliliter or even several tens of micro-litters was filtered by an alumina membrane through the vacuum filtration, and an ultra-thin CNT film was formed onto the alumina membrane. Thereafter, the alumina membrane was solvated by acetone, and the floating CNT film was easily transferred to indium-tin-oxide (ITO) glass substrate in an area defined as 1 cm with a film mask. The CNT film was subjected to an activation process with an adhesive roller, erecting the CNTs up to serve as electron emitters. In order to measure their luminance characteristics, an ITO-coated glass substrate having phosphor was employed as an anode plate. Our field emitter array (FEA) was fairly transparent unlike conventional FEAs, which enabled light to emit not only through the anode frontside but also through the cathode backside, where luminace on the cathode backside was higher than that on the anode frontside. Futhermore, we added a reflecting metal layer to cathode or anode side to enhance the luminance of light passing through the other side. In one case, the metal layer was formed onto the bottom face of the cathode substrate and reflected the light back so that light passed only through the anode substrate. In the other case, the reflecting layer coated on the anode substrate made all light go only through the cathode substrate. Among the two cases, the latter showed higher luminance than the former. This study will discuss the morphologies and field emission characteristics of CNT emitters according to the experimental parameters in fabricating the lamps emitting light on the both sides or only on the either side.

Key Words : carbon nanotube, field emission, transparent film, sodium dodecyl sulfate, luminance