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Luminous Characteristics of Transparent Field Emitters Produced by Using Ultra-thin Films of Single Walled Carbon Nanotubes

Eunsoo Jang, Jeungchoon Goak, Hansung Lee, Seungho Lee, Naesung Lee†

Faculty of Nanotechnology and Advanced Materials Engineering, Sejong University
(nslee@sejong.ac.kr†)

Carbon nanotubes (CNTs) are attractive material because of their superior electrical, mechanical, and chemical properties. Furthermore, their geometric features such as a large aspect ratio and a small radius of curvature at tip make them ideal for low-voltage field emission devices including backlight units of liquid crystal display, lighting lamps, X-ray source, microwave amplifiers, electron microscopes, etc. In field emission devices for display applications, the phosphor anode is positioned against the CNT emitters. In most case, light generated from the phosphor by electron bombardment passes through the anode front plate to reach observers. However, light is produced in a narrow depth of the surface of the phosphor layer because phosphor particles are big as much as several micrometers, which means that it is necessary to transmit through the phosphor layer. Hence, a drop of light intensity is unavoidable during this process. In this study, we fabricated a transparent cathode back plate by depositing an ultra-thin film of single walled CNTs (SWCNTs) on an indium tin oxide (ITO)-coated glass substrate. Two types of phosphor anode plates were employed to our transparent cathode back plate: One is an ITO glass substrate with a phosphor layer and the other is a Cr-coated glass substrate with phosphor layer. For the former case, light was radiated from both the front and the back sides, where luminance on the back was ~30% higher than that on the front in our experiments. For the other case, however, light was emitted only from the cathode back side as the Cr layer on the anode glass rolled as a reflecting mirror, improving the light luminance as much as ~60% compared with that on the front of one. This study seems to be discussed about 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 cathode back side. The experimental procedures are as follows. First, a CNT aqueous solution was prepared by ultrasonically dispersing purified SWCNTs in deionized water with sodium dodecyl sulfate (SDS). A milliliter or even several tens of micro-liters of CNT solution was deposited onto a porous alumina membrane through vacuum filtration. Thereafter, the alumina membrane was solvated with the 3 M NaOH solution and the floating CNT film was easily transferred to an ITO glass substrate. It is required for CNT film to make standing CNTs up to serve as electron emitter through an adhesive roller activation.

Keywords: carbon nanotube, field emission, transparent film, sodium dodecyl sulfate

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Fabrication of Transparent Heat-element using Single- Walled Carbon Nanotubes

정혁, Nguyen Van Quy, 이한민, 김동현, 김도진†

충남대학교
(dojin@cu.ac.kr†)

In this research, single walled carbon nano-tube film was manufactured with spray coating method on glass for application as transparent heat element. SWNTs solution to be used for spraying is obtained by dispersion of 0.01 wt% purified SWNTs in dimethylformamide (DMF) solution through ultrasonification and centrifugation. The transmittance and sheet resistance of SWNTs film were determined by the number of spray injection. Manufactured SWNTs film will have sheet resistance range of 200 Ω/□-900 Ω/□ at transmittance range of 70-90 %. Heat generation characteristic of SWNTs film was measured by applying constant DC voltage of 15V. The result confirmed that SWNTs film with sheet resistance of 200 Ω/□ reaches surface temperature of 80℃ within several seconds. In addition, PET coating film was coated on top of the SWNTs film by using laminator in order to solve weak adhesive property of the spray coated SWNTs film on the substrate as well as to maintain its electrical and optical properties.

Keywords: Single walled carbon nanotube, Transparent heat element film