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수직배향된 단일벽 탄소나노튜브 필름의 전계방출 특성

Field Emission Characteristics of Aligned Single-walled Carbon Nanotube Papers

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Carbon nanotubes have drawn much attention because of their promising potential to be applicable to field emission sources, such as field emission displays, microwave power amplifiers, and other vacuum microelectronic devices. The key issue for these applications is that CNTs should be able to produce high emission currents and to be strong enough to sustain stable emission in a long-term operation without a catastrophic failure. Electron emitters, in particular, for microwave power amplifiers, usually require at least the emission current density as high as 20mA/cm². Such high currents are achievable from CNTs only when the population density of CNTs is optimized in terms of the screening effect between adjacent CNTs and the number of working emitters. Although much effort has been made to control the density of CVD-grown CNTs on substrates as well as screen-printed CNTs, the density control is yet to be studied further. In this work, bulky and thick papers of functionalized SWCNTs were made using membrane filtration. It was observed that SWCNTs on the papers were vertically aligned and density-controlled. The vertical alignment of SWCNTs seemed to be achieved because the SWCNTs were vacuum-filtrated through pores of a filter paper. We could also vary the density of vertically aligned SWCNT emitters by changing the pore density and sizes of the filter papers. The field emission current-voltage behaviors were investigated for planar surfaces and cross-sections of SWCNT papers. It was noted that uniform field emission images on phosphor were observed for the planar surfaces, while high emission current density was obtained for the cross-sections.