One-step liquid-phase fabrication of adhesive and protective inorganic layer for carbon nanotube field emitters

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Abstract : we have investigated the field emission characteristics of the CNT/TEOS hybrid thin films fabricated by a spray method. It is found that the CNT/TEOS hybrid emitters show high current density, low turn on field, and long-term emission stability compared to the CNT emitters. These efficient field emission characteristics of the CNT/TEOS hybrid emitters are attributed to the TEOS sol, acting as a protection layer of nanotube emitter by surrounding the nanotube tip as well as a binder material to enhance the adhesion of nanotube emitters to the substrate. Therefore, the CNT/TEOS hybrid emitters could be utilized as an alternative for the efficient and reliable field emitters.

Key Words : field emitter, carbon nanotube, inorganic binder, adhesive layer, protective layer

1. 서 론

One of important issues in carbon nanotubes (CNTs)-based field emitter is the long-term stability of the emission current. Many studies have been devoted to realize the stable emission through performing the strong adhesion of nanotube emitters to the cathode substrate or protecting the emitter tips by using the inorganic binders. Silane sols prepared by precursors such as MTMS, VTMS, PTMS, and TEOS have been widely used for the composite materials to improve the mechanical and environmental properties of the CNTs. Among these silanes, TEOS sol could be adopted to the nanotube binder for field emitters because it does not contain the organic material which can be easily degassed during field emission, and has an advantage of low curing temperature which can be applied to the flexible substrate.

2. 결과 및 토의

We introduce the hybrid CNT/TEOS binder thin films fabricated by the conventional spray method for highly efficient and reliable field emitters. Sol-gel chemistry was introduced to achieve the stable CNT/TEOS sol solution for the spray. We observed that the high emission current and low turn-on field of the hybrid CNT/TEOS sol thin film emitters are attributed to the high number density of efficient emitters, resulting from the strong adhesion of nanotube emitters to the substrate. It was also found that the hybrid CNT/TEOS emitters have better long-term emission stability compared to the CNT emitters. This stable emission of the CNT/TEOS sol hybrid thin films could be well interpreted in terms of the nanotube passivation using TEOS capping layers.

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