Fabrication of carbon nanotube emitters by filtration through a metal mesh

Ju Sung Choi, Han Sung Lee, Jeung Chun Gwak, and Naesung Lee*

Faculty of Nanotechnology and Advanced Materials Engineering, Sejong University, Seoul 143-747, South Korea
*nslee@sejong.ac.kr

Abstract : Carbon nanotubes have drawn attention as one of the most promising emitter materials ever known not only due to their nanometer-scale radius of curvature at tip and extremely high aspect ratios but also due to their strong mechanical strength, excellent thermal conductivity, good chemical stability, etc. Some applications of CNTs as emitters, such as X-ray tubes and microwave amplifiers, require high current emission over a small emitter area. The field emission for high current density often damages CNT emitters by Joule heating, field evaporation, or electrostatic interaction. In order to endure the high current density emission, CNT emitters should be optimally fabricated in terms of material properties and morphological aspects: highly crystalline CNT materials, low gas emission during electron emission in vacuum, optimal emitter distribution density, optimal aspect ratio of emitters, uniform emitter height, strong emitter adhesion onto a substrate, etc. We attempted a novel approach to fabricate CNT emitters to meet some of requirements described above, including highly crystalline CNT materials, low gas emission, and strong emitter adhesion. In this study, CNT emitters were fabricated by filtrating an aqueous suspension of highly crystalline thin multiwalled CNTs (Hanwha Nanotech Inc.) through a metal mesh. The metal mesh served as a support and fixture frame of CNT emitters. When 5 ml of the CNT suspension was engaged in filtration through a 400 mesh, the CNT layers were formed to be as thick as the mesh at the mesh openings. The CNT emitter sample of 1x1 cm^2 in size was characteristic of the turn-on electrical field of 2.7 V/μm and the current density of 14.5 mA at 5.8 V/μm without noticeable deterioration of emitters. This study seems to provide a novel fabrication route to simply produce small-size CNT emitters for high current emission with reliability.

Key Words : CNT, Filtration, Mesh, Emitter

† 교신저자) 이내성, e-mail: nslee@sejong.ac.kr, Tel:02-3408-3786
주소: 서울 광진구 군자동 세종대학교 나노신소재공학과