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Surface structure modification of vertically-aligned carbon nanotubes and their characterization of field emission property

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Vertically-aligned carbon nanotubes (VCNT) have attracted much attention due to their unique structural, mechanical and electronic properties, and possess many advantages for a wide range of multifunctional applications such as field emission displays, heat dissipation and potential energy conversion devices. Surface modification of the VCNT plays a fundamental role to meet specific demands for the applications and control their surface property. Recent studies have been focused on the improvement of the electron emission property and the structural modification of CNTs to enable the mass fabrication, since the VCNT considered as an ideal candidate for various field emission applications such as lamps and flat panel display devices, X-ray tubes, vacuum gauges, and microwave amplifiers.

Here, we investigate the effect of surface morphology of the VCNT by water vapor exposure and coating materials on field emission property. VCNT with various height were prepared by thermal chemical vapor deposition: short-length around 200 μm, medium-length around 500 μm, and long-length around 1 mm. The surface morphology is modified by water vapor exposure by adjusting exposure time and temperature with ranges from 2 to 10 min and from 60 to 120oC, respectively. Thin films of SiO2 and W are coated on the structure-modified VCNT to confirm the effect of coated materials on field emission properties.

As a result, the surface morphology of VCNT dramatically changes with increasing temperature and exposure time. Especially, the shorter VCNT change their surface morphology most rapidly. The difference of field emission property depending on the coating materials is discussed from the point of work function and field concentration factor based on Fowler-Nordheim tunneling.

Keywords: Vertically-aligned carbon nanotubes, surface morphology, field emission