Electron Emission of Carbon Nanonets
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Carbon nanotubes have been attracting attention because of their unique physical properties and their application potential for field emission cathode. Carbon nanotubes possess the following properties favorable for field emission material, such as a high aspect ratio and sharp tip, high chemical stability, high mechanical strength, stable at high temperature. Some research works on carbon nanotubes field emitter and field emission display have been reported.

Carbon nanotubes usually are used as cold cathode materials by printing on substrates. But carbon nanotubes distribute generally is not uniform. Some carbon nanotubes cold cathode fabricated by CVD on silicon substrates, although they have very high density, these carbon nanotube bundles with very high density produce electrical field shield, and couldn’t produces large field enhance actions. Here, a kind of carbon nanonets and its field emission properties are introduced. they have similar properties with carbon nanotubes, but the density is lower than carbon nanotubes bundles. These carbon nanonets are directly synthesized by liquidoid epitaxy method on silicon substrates at low temperature and have better purity. the field emission properties of carbon nanonets are reported too.

Carbon nanonets film is synthesized in methanol base liquid by electrolysis. The graphite plate is as anode, and n-silicon substrate with resistivity of 13-18 Ω cm is as cathode. The electrolysis current is about 4-15mA/cm², and applied voltage is 1000-3000V. Deposition of carbon nanonets is carried out at 60°C. Carbon nanonets is observed by scanning electron microscopy(SEM). Raman spectrum of carbon nanonets film shows the two peaks at 1365 and 1580 cm⁻¹. The field emission properties of carbon nanonets are measured in high vacuum chamber(10⁻⁷Pa). The emission area of carbon nanonets is 0.3cm×0.5cm.

Fig.1(a, b.) show some surface micrograph of carbon nanonets film deposited by electrolysis in methanol base solution at different conditions. It’s found that diameter of nanotubes are about 200nm. Surface structure of carbon nanonets is also different with synthesis conditions. The thresholds of field emission of these carbon nanonets film are between 1.8V/μm and 3.4V/μm.

According to research results, it is found that liquidoid synthesis of carbon nanonets film is simple method to produce carbon nanonets cold cathode material, and the carbon nanonets have better better purity and field emission properties.

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References:
(a) Synthesis conditions: 1800V and 10mA/cm², 60°C.

(b) Synthesis conditions: 1400V and 10mA/cm², 60°C.

(c) Synthesis conditions: 1500V and 5mA/cm², 60°C.

Fig.1(a,b,c), microstructure of carbon nanonets synthesis at different conditions.