Investigation of Carbon Nanotubes Grown at Low Temperature for Field Emission Display

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Abstract

In order to decrease the price and improve the uniformity of CNT-FEDs, the thermal CVD process is necessary for the synthesis of CNTs on glass substrate at a low temperature below the melting point of glass (~570℃). For the growth of CNTs on glass substrate at low temperature, the melting point of catalyst is one of the critical factors. In our study, two novel catalysts NiPd and FeC were discovered for CNT growth at low temperature. The lowest melting points 1237 ℃and 1147 ℃ occur as the weight percentages of NiPd and FeC are Ni:Pd = 40:60 and Fe:C=95.7:4.3, respectively. As compared with the mono-metal, the alloys were more suitable for CNTs growth at low temperature because of the lower melting points. In our research, the CNTs grown at low temperature with NiPd and FeC as the catalysts revealed superior field emission characteristics. The CNTs grown by NiPd especially showed a low turn-on field (3.7 V/um) and a high current density (152.3 mA/cm^2). Moreover, the density of CNTs is about 10^{10}/cm^3.

For the gated triode structures, the under-gate and planar-gate structures were fabricated

with various thicknesses of dielectric layers and the relative positions between CNT tips and gate electrode. And we expected that the under-gate structure would contribute to the anode current control and the reduction of gate leakage current.

Finally, CNTs were grown on glass substrate at low temperature by utilizing novel catalysts as described above. The luminescent image that corresponded to the electron emission from the CNTs was obtained on the anode phosphor substrate which is applied a high voltage.

The uniform CNT films were grown successfully at low temperature with the novel catalysts by thermal CVD. Simultaneously, CNTs were grown on glass substrate for the application of field emission display. We think that the field emission display will be developed if a proper gate structure is combined with the glass substrate. Then, we expect that a large size field emission display with higher resolution will be fabricated in the future.