# TRIODE TYPE CARBON NANOTUBE FIELD EMITTER FABRICATED USING REGULARLY ARRAYED NANOPORE TEMPLATE

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Now it is well known that carbon nanotube has an excellent emission properties and can be applied for field emission display. However, the length scale of the system is limited to several hundreds of micronmeters due to the non-uniform length of the carbon nanotubes involved in the application techniques and/or the self-assembling nature of the carbon nanotube growth. The weak adhesion to substrate has also been a trouble in the CVD grown carbon nanotubes. We reported here a new fabrication method for triode type carbon nanotube field emitter using synthesis of carbon nanotubes on anodic aluminum oxide(AAO) template in order to overcome those obstacles.

AAO is recently emerged template for application to synthesis of nano materials because of its regular array of nanopores. The schematic flow for the device fabrication is shown in the figure. AAO was fabricated with Al deposited on Si wafer using electro-plating method (a). Au was then selectively deposited as a gate metal on AAO (b). Dry and wet etching processes were carried out using the Au patterns as mask to control the distance between the gate and the cathode. It was followed by synthesis of carbon nanotubes using PECVD method at 700 using $C_2H_2$ / $NH_3$ mixture gases (c). At the final step, the AAO structure was partially etched to expose the carbon nanotubes while maintaining the strong adhesion between nanotubes and substrate. Thus, one could achieve carbon nanotube emitters of uniform length and strong adhesion.

The morphology and crystallinity of nanotube were examined by FE-SEM, HRTEM and Raman spectroscopy. The detail fabrication procedure and involved issues will be discussed. This new triode structure field emitter has a very low turn-on voltage and high current density of few tens $mA/cm^2$ although the carbon nanotube structure was relatively poor. The new fabricating process can be applied to a mass production of triode-type field emission devices having high performance.

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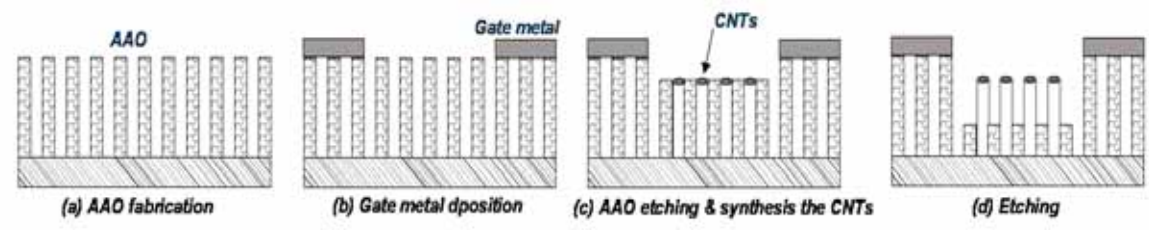


Fig. 1. Schematic flow of the AAO-based carbon nanotube emitter fabrication..