탄소나노튜브의 전계방출을 이용한 신개념 엑스레이 광원
New X-Ray Source Using Field Emission of CNT

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Conventional X-ray source reveals several problems such as short lifetime, immovability with bulky size, and relatively low resolution. For solving these problems, many technologies were developed to invent new x-ray sources. For example, laser based X- ray sources have been applied but they were insufficient for X-ray source because of its low conversion efficiency. Recently, O. Zhou and Okuyama *et al.,*[1-2] has developed a new X-ray emission method by using field emission of carbon nanotubes. Carbon nanotubes (i.e., CNTs) are tubular carbon molecules with properties that make them potentially useful in extremely small scale electronic and mechanical applications. In the present study, CNTs were grown by thermal CVD method as high as 30~50㎛ and these grown CNTs were utilized for an X-ray emitter. The X-ray emitter has a triode structure that is consisted with a cathode, a grid, an electron focusing lens, and an anode. Distances between the parts are approximately 400㎛, 500㎛, and 1.5㎝, respectively. The electrical properties of the grown CNT emitter were tested in a vacuum chamber and the results were acquired automatically by Labview program. The total potential energies for accelerating electrons from the CNT emitter were 10~20 kV. The X-ray wavelength was calculated about 12 nm~6 nm resulting in near EUV or soft X-ray region. Electron beam focusing characteristics were also investigated by using Opera 3D code and the positions of individual electrodes in the triode were optimized for the best X-ray generation. Typical x-ray images were obtained and the detailed descriptions of the manufactured x-ray triode were discussed in detail.

1. Yuan Cheng and Otto Zhou, "Electron field emission from carbon nanotubes", C. R. Physique 4 (2003) 1021-1033
2. H. Sugie, M. Tanemura, V. Filip, K. Iwata, K. Takahashi, and F. Okuyama. "Carbon nanotubes as electron source in an x-ray tube", Appl. Phsy. Letters. vol. 78, 2578-2580

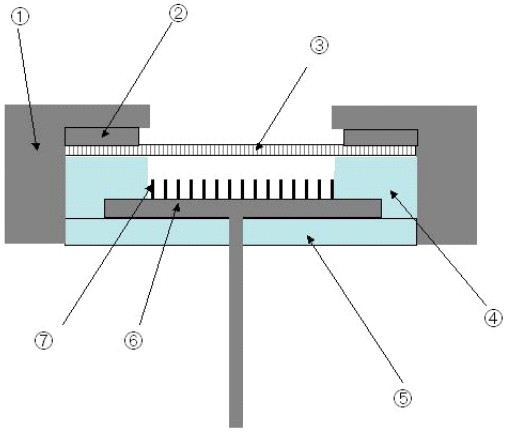

Figure 1. A triode structure used in the present work

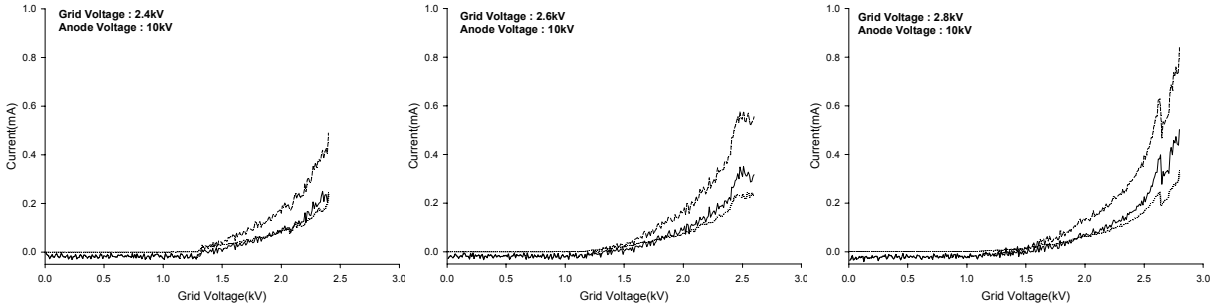

Figure 2. Emission current relative to the voltage on the grid

Figure 3. Acquired Images using field emission of CNT