Fabrication of high-resolution X-ray source with carbon nanotube emitters based electron beam (C-beam)

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We demonstrated high-resolution X-ray source using triode cold cathode electron beam (C-beam) module. The module consists of vertically aligned carbon nanotubes (VACNTs) and gate mesh structure for electron extraction under high electric field applied circumstances. With cylindrical focusing electrode on the triode C-beam module, focal spot sizes (FSSs) of 0.1 mm were achieved. Due to the small divergence angle of e-beam from our VACNTs, smaller FSSs were achieved than any other cold cathodes employed X-ray sources[1]. Furthermore, our X-ray source represents better electron to photon conversion efficiency owing to the remarkably reduced gate leakage. The electron transmittance of our modules showed about 93 % and indeed improved dose characteristics were observed compare with other cold cathode driven X-ray devices. In the paper, structure of our C-beam and our X-ray source will be delivered in detail. In terms of X-ray quality, spatial resolution and image quality results will be discussed. The authors expect our simple but sophisticated C-beam will pave advanced X-ray modalities due to the robust spatial resolution and high image quality characteristics.

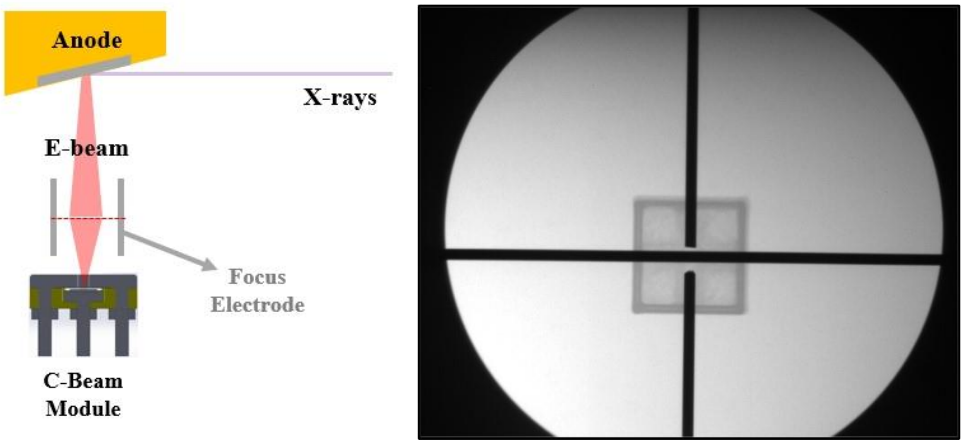

Figure 1: (left) Schematic of C-beam based reflection type X-ray system and (right) X-ray image of crossed W wires for focal spot size (FSS) measurement.

[1]J. W. Kim, J. W. Jeong, J. T. Kang, S. Choi, S. Ahn, and Y. H. Song, Nanotechnology 25, 065201 (2014).