室温形成 1 次元銅ナノ構造体の形態制御とその電界電子放射特性

Morphological control of 1D copper nanostructure grown at room temperature and their field emission properties

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Copper nanostructures have started to gain wide attention due to their magnificent properties such as high electrical conductivity, thermal conductivity, malleability and ductility which make it a promising material for many future application including field electron emission [1]. Field emission properties can be improved by controlling the size, morphology, density and composition of emitter [2]. Furthermore, the direct growth of well align emitter on conductive metal substrate can also improve the field emission properties as it minimize the contact resistance between the emitter and the substrate [3]. In this regard, we challenge to synthesis and control a morphology a Cu nanostructures directly on Cu substrate at room temperature for application in field emission displays (FEDs). In our approach, Cu nanostructures were fabricated on Cu substrate by bombardment with Ar^+ ions using Kaufman type ion gun (ION TECH. INC. Ltd., model 3-1500-100FC) at room temperature. Cu substrate was mounted on the sample stage and a graphite plate; the supplier of carbon atom was place perpendicularly at the edge of substrate. Their morphology and compositional control could be archived by simultaneous supply of carbon particles during ion irradiation. Conical nanostructures were formed on the Cu substrate with less carbon supply whereas those with a simultaneous carbon supply featured mainly needle-like structures with various length. The field electron emission (FE) properties, measured using parallel plate configurations in 10^{-4} Pa range showed the threshold fields of 4.3 and 9.2 V/μm with a current density of 1.0 μA/cm^2 for the needle-like and conical structure, respectively. The needle-like structure showed higher current density than conical structure at 10 V/μm; 4.4 mA/cm^2 and 5.7 μA/cm^2, respectively. Our experimental results are very much comparable to those for CNT grown on Iconel 600 substrate and suggest that Cu nanostructures grown directly on Cu substrate exhibit excellent field emission behaviour [3]. The details findings will be discussed in the presentation.

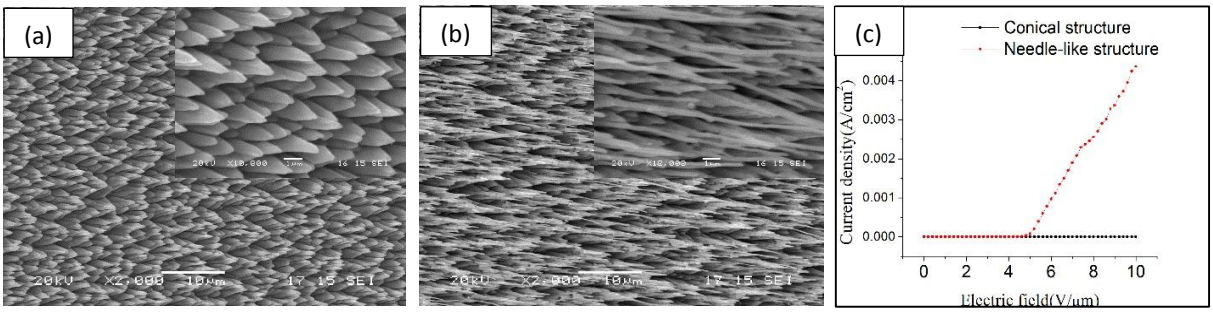

Fig 1 SEM images of (a) conical, (b) needle-like Cu structure and (c) emission current density versus applied electric field for the conical and needle-like structure of Cu.

References:

[1] S. Bhanushali *et al.*, Small. 11 (2015) 1232.
[2] Y. Yaakob *et al.*, Japanese J. Appl. Phys. 52 (2013) 1.
[3] P. Ghosh *et al.*, Chem Commun. 47 (2011) 4820.