Copper Oxide Nanowire Arrays Synthesized from Sputtered Cu Thin Film

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The copper oxide nanowires are applicable to various nanodevices such as field-emission devices, gas sensors, and field-effect transistors. The nanowires are suitable especially for field-emission emitters, because copper oxide has a low work function. It is useful for the device integration that the nanowires can be synthesized directly from Cu thin film seed.

The nanowires were synthesized by simple annealing of sputtered Cu thin film in a furnace. 1-μm-thick Cu thin films were deposited on Si substrates by magnetron rf sputtering. 30-nm-thick Cr thin films were sputtered between Si and Cu films to avoid detaching of Cu from Si. The samples were loaded into a furnace and then annealed to 400 °C from room temperature for 1 min and maintained the temperature for 0~100 min with the atmosphere flow of 2.5 L/min. Figures1(a-f) show the SEM images of the initial Cu thin film and synthesized nanowires with the annealing time of 1/3/10/30/100 min. The nanowires grew longer as the annealing time. The base film became thicker after annealing. The Cu thin film may be oxidized and the iron oxide diffused to the roots of nanowires as the solid-phase growth model or they may be vapored and then deposited on the surface of nanowires as the vapor-liquid-solid model. We characterized the nanowires by transmission electron microscopy (TEM) (Fig. 2). The nanobeam diffraction pattern indicates monoclinic CuO crystal.

Reference: C. -C. Yeon *et al., J. Vac. Sci. Technol* **24** (2006) 940.

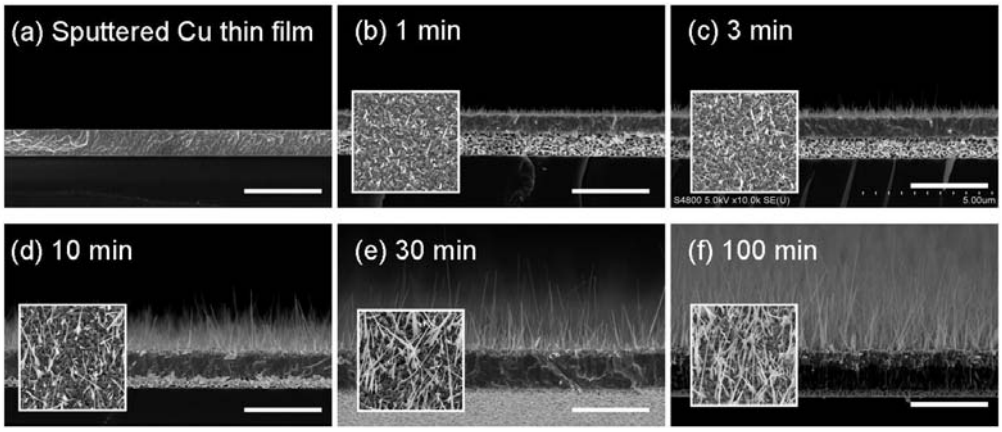

Figure 1. Cross-sectional SEM images of the Cu thin film(a) and synthesized cupper oxide nanowires with the annealing time of 1(b), 3(c), 10(d), 30(e), 100 min (f). Insets were their tilted views (45 deg.). All the scale bars indicate 3 μm.

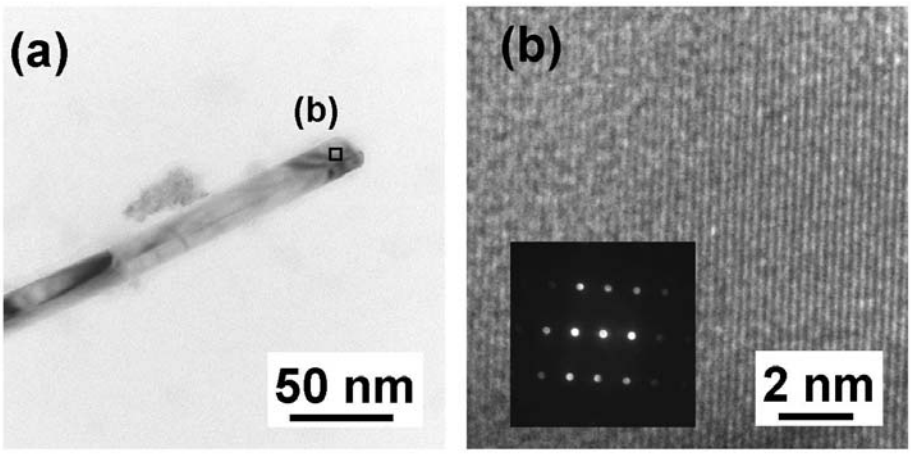

Figure 2. TEM images of the nanowires; Low(a) and high(b) magnification images. An inset of (b) shows a nano-beam diffraction pattern at the area of (b) (annealing time: 30 min).