Direct synthesis of vertical α-Fe_2O_3 nanowires from sputtered Fe thin film

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The vertically synthesized α-Fe_2O_3 (hematite) nanowires are applicable to various nanodevices such as field-emission devices, gas sensors, and field-effect transistors. α-Fe_2O_3 nanowires are well-known that they can be synthesized by oxidation of Fe bulk, however, no research reports that deposited Fe can be the seed layer. Thin film seed is useful for the device integration.

The blade-like nanowires were synthesized by simple annealing of sputtered Fe thin film in a furnace. 200-nm-thick Fe thin films were deposited on Si substrates by magnetron rf sputtering. 30-nm-thick Cr thin films were sputtered between Si and Fe films to avoid detaching of Fe from Si. The samples were loaded into a furnace and then annealed to 375 °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 Fe thin film and synthesized nanowires with the annealing time of 0/1/3/10/30 min. The nanowires were longer as the annealing time is longer. The density is saturated at the annealing time of 0~1 min. The thickness of the Fe film became thicker as the annealing time (0~1 min). The Fe 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 Raman spectroscopy (Fig. 2). The Raman shift indicates the α-Fe_2O_3. This result may include the oxidized Fe film.

Reference: C. H. Kim *et al.*, *Appl. Phys. Lett.* **89** (2006) 223103.

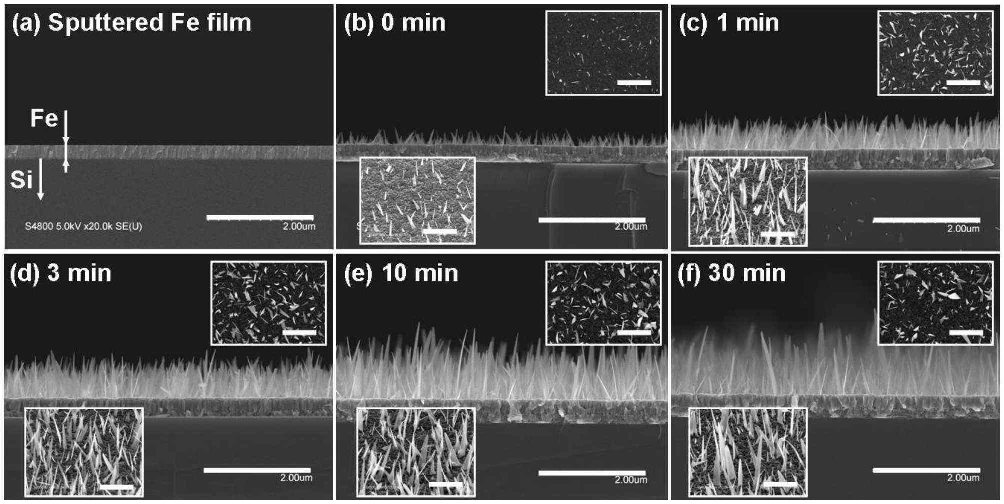

Figure 1. Cross-sectional SEM images of the Fe thin film(a) and synthesized iron oxide nanowires with the annealing time of 0(b), 1(c), 3(d), 10(e), 30 min (f). Insets were their top views and tilted views (45 deg.). All the scale bars indicate 2 μm.

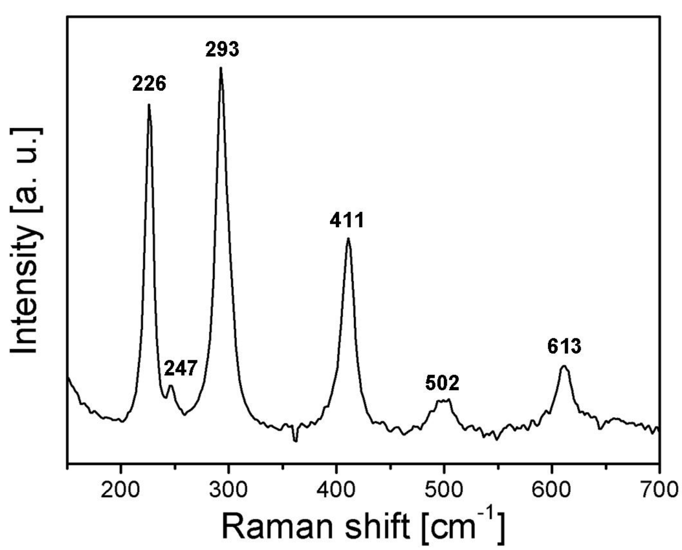

Figure 2. Raman shift of the nanowires (annealing time: 30 min).