18p-A6-11

Growth and characterization of molybdenum oxide nanorods by one-step sol-gel spin coating method

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As an indirect wide band-gap semiconductor material, molybdenum oxide (MoO_3) have attracted much attention. In particular, various one-dimensional (1-D) nanostructures of MoO_3 indicate a great potential for applications in catalysts, display devices, gas sensors, and solar cells because of their high surface volume ratio, superior crystallinity, and excellent electron transportation. Recently, M.E.Kurtoglu *et al*. reported that α-MoO_3 nanobelts had been synthesized by dip coating of molybdenum pentachloride ($MoCl_5$) solution onto TiO_2 coated glass [1]. The study has opened a door to achieve various one-dimensional (1-D) nanostructures of MoO_3 by simple yet efficient sol-gel methods. However, the multi-step method is much complex and expensive, and thus it has been an urgent issue to look for synthetic procedures to make 1-D nanostructures of MoO_3. In this work, we proposed a one-step sol-gel method to fabricate α-MoO_3 nanorods with simple spin coating and annealing process.

Ammonium molybdate ($(NH_4)_2MoO_4$, 0.5 M) and citric acid ($C_5H_8O_2$, Anhydrous, 1.5 M), were firstly dissolved in 2-Methoxyethanol (2-ME, 5 ml) to yield a blue transparent solution after 4 hours magnetic stirring, followed by aging at room temperature for 24 hours. The mixture was deposited on a silica substrate via spin coating at 1000 rpm for 10 seconds and then baked at 100 ℃ for 5 minute. The cycle was repeated for three times to get a sufficient thickness of the film. The film was finally sintered at 400 ℃ for 15 minutes in air.

Typical cross-section SEM image of the obtained film is shown in **Fig. 1(a)**. Needle-like particles originated from the film have been observed with 20-30 nm width and 300-500 nm length. **Fig. 1(b)** gives the XRD pattern of the film. It indicates the presence of diffraction peaks of a typical thermodynamically stable phase of α-MoO_3 (JCPDS No.05-0508). Compared with the standard XRD pattern, (0k0) diffraction peaks with k = 2, 4, 6 are obviously higher, suggesting highly anisotropic crystal orientation. The details in the growth mechanism will be presented in the conference.

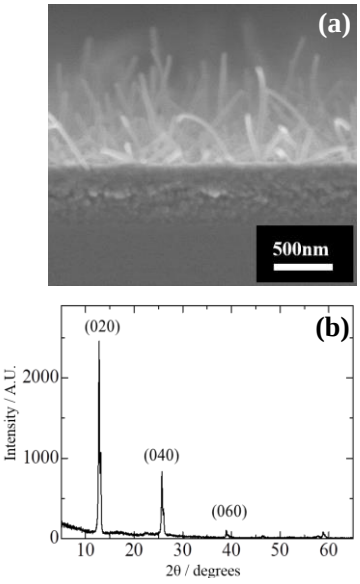

Figure 1. Characterization of obtained MoO_3 nanorods on silica substrate by (a) cross-section SEM, and (b) XRD spectrum.

[1] M. E. Kurtoglu, T. Longenbach and Y. Gogotsi, *J. Mater. Chem.* **21**, 7931-7936(2011).