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単斜晶WO_3薄膜抵抗率の熱処理依存性

Resistivity dependence of Monoclinic Thin Tungsten Oxide Film on Annealing Processes

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Introduction

Tungsten oxide (WO_3) as a promising candidate for visible light-driven photocatalyst, has attracted a strong interest owing to its narrow band gap (about 2.6eV), strong light absorption, deep valence band, easy synthesis, and nontoxicity [1]. For the application of photocatalyst, WO_3 needs high electron transport which can suppress the recombination of photogenerated electron-hole pairs thus improve the performance of photocatalyst [2]. In this study, we measured the resistivities of monoclinic WO_3 thin film after different annealing processes and gave a proposal of how to obtain high electron transport in WO_3.

Experiment

Tungsten oxide nanopowder with BET specific surface area value of 37 m^2/g was sprayed on the SiO_2 (400nm) substrate with aqueous dispersion. Then the substrate was annealed at 450°C for 30 minutes. The monoclinic tungsten oxide with thickness of 150nm and porosity of 35% was formed. The resistivity of the sample was measured by four-point prober method and tungsten metal was chosen as the four-point pattern electrode material. At first, the 50nm tungsten metal was deposited on the prepared tungsten oxide substrate by RF magnetron sputtering and was patterned by H_2O_2 wet etching to form four-point pattern electrodes. Resistivities were measured on the sample without annealing, then measured again after N_2 annealing at 300°C, and measured again after 5% O_2 atmosphere at 300°C.

Results and Discussion

Fig. 1 shows the resistivity of monoclinic tungsten oxide depending on the measurement temperatures increasing from 243K to 443K (in a representation of ln ρ versus 1000/T). Compared with the resistivity of the original sample, lower resistivity was found after N_2 annealing at 300°C with almost the same slope of reverse temperatures as that of original sample. Then the N_2-annealed sample was annealed in 5% O_2 atmosphere at 300°C for 5 minutes. The resistivity returned to almost the same as that of original sample. The change of resistivity can be explained by oxygen vacancy generation and repair in tungsten oxide during annealing processes. The detail will be reported in the meeting.

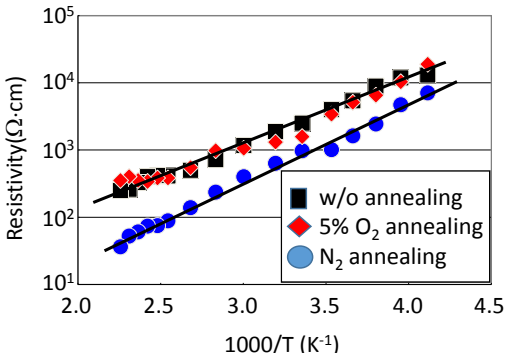

Fig. 1. The natural logarithm resistivity versus 1000/T at different annealing atmospheres

Reference

[1] F. Wang, *et. al.*, *ChemCatChem*, *vol.* 4, 4, 476 – 478 (2012).

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