Fabrication of nano-structure for Sb_2Te_3

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1. INTRODUCTION

We have studied nano-structure of chalcogenide [1] because we are interested in physical property of chalcogenide nano-structure for applying them to memory devices. In this paper, we report nano-structure shape of Sb_2Te_3 fabricated by various annealing conditions. A scanning electron microscope (SEM) and an atomic force microscope (AFM) were used for observing shapes.

2. EXPERIMENTS

Nano-structure is fabricated by annealing after sputtering Sb_2Te_3 with the thickness of 5 nm on Highly Oriented Pyrolytic Graphite (HOPG). HOPG was used as substrate because its surface flatness is atomic level and it is easy to recognize nano-structure on it. Sputtering conditions are described below; Ar gas flow rate:10 sccm, gas pressure: 0.7 Pa, and RF magnetron power:50 W. After the deposition, we carried out annealing process at 200 or 250 ℃ with the annealing speed of 10 ℃/ min. And we kept its temperature for 5 min. Shape observation of nano-structure was carried out by SEM and AFM.

3. RESULTS AND DISCUSSION

Fig. 1 is an SEM image after annealing Sb_2Te_3 film at 200 ℃ for 5 min. It is clearly seen that nano-particles with 5 to 25 nm diameter are generated. We analyzed the distribution of the diameter, and 65% Sb_2Te_3 has the diameter within 5 to 15 nm and the 35% has the diameter within 15 to 25 nm. Fig. 2 is an SEM image after annealing at 250 ℃ for 5 min. Nano-needle structure with the length of several tens hundreds nm and the width of 50 nm were produced. These needles are not only lying but also standing on the substrate surface. We annealed Sb_2Te_3 thin film at 200 ℃ for 60 min, nano-needle structures were also generated shown in Fig. 3. We carried out AFM observation to obtain structure information of the needle. Fig. 4 is an AFM image of the nano-needle structure. Flat portion was observed on this AFM images, therefore, we think that the nano-needle structure have possibly quadratic shape.

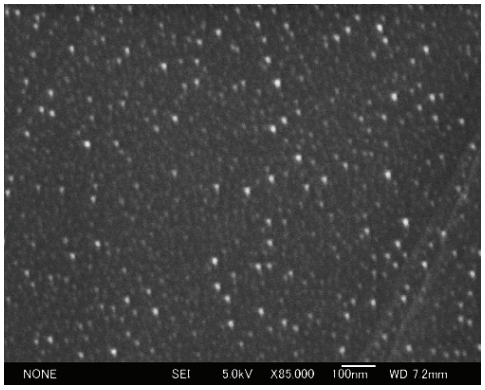

Fig. 1 SEM image of nano-particles after annealing at 200 ℃ for 5 min.

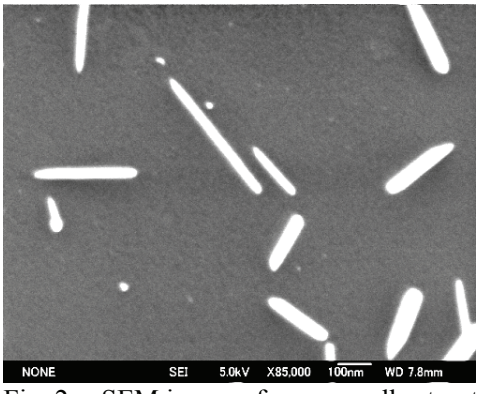

Fig. 2 SEM image of nano-needle structures after annealing at 250 ℃ for 5 min.

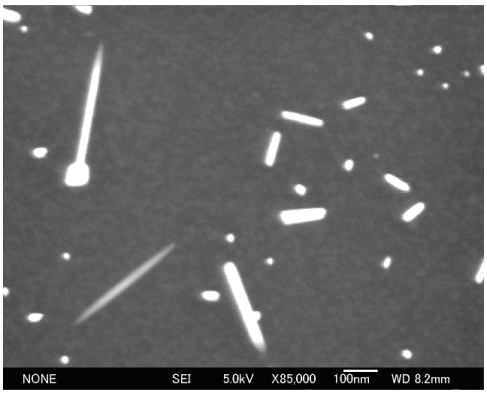

Fig. 3　SEM image of nano-needle structures after annealing at 200 ℃ for 60 min

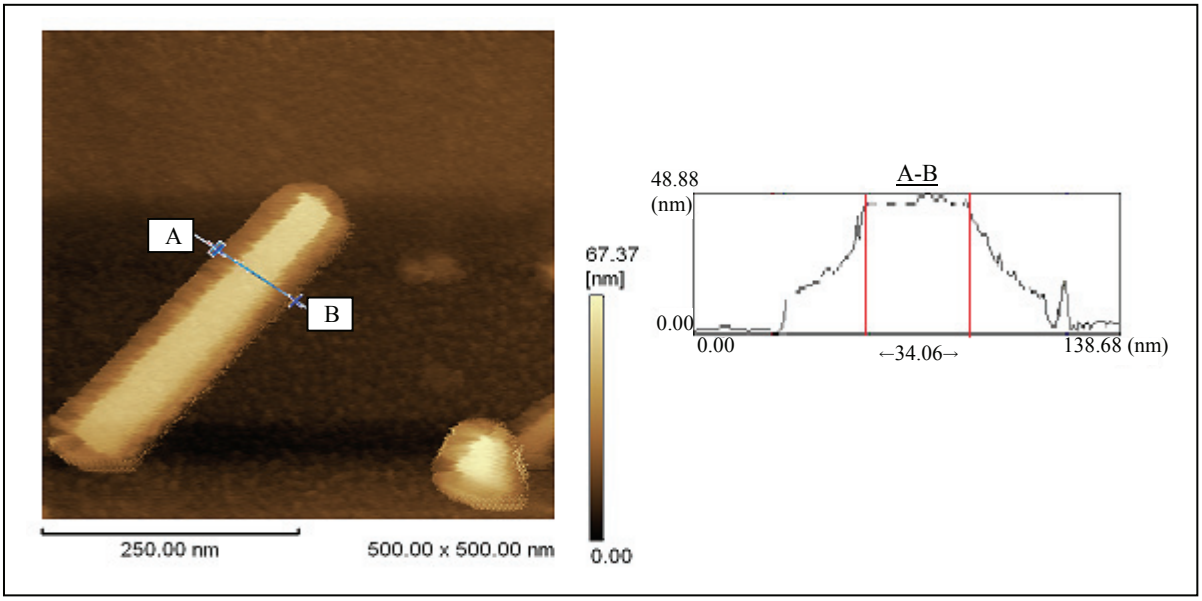

Fig. 4　AFM image of top (left) and cross-sectional view (right) of the nano-needle structure. Flat portion was clearly seen.

4. CONCLUSION

We carried out fabrication of Sb_2Te_3 nano-structure by annealing, and studied the shape depending on annealing temperature and time by SEM and AFM. Nano-particle structures were produced at 200 ℃ for 5min, on the other hand, nano-needle structure appeared on substrate at 250 ℃ for 5min and 200 ℃ for 60 min. From AFM observation, the nano-needle structure would have quadratic shape. In the future works, we will plan to measure electric and optical properties to individual nano-structure using SPM and TEM.

ACKOWLEADGMENT

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REFERENCES

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