Characterization of InSbTe nanowires grown directly by MOCVD for high density PRAM application

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Abstract : Recently, the nanowire configuration of GST showed nanosecond-level phase switch at very low power dissipation, suggesting that the nanowires could be ideal for data storage devices. In spite of many advantages of IST materials, their feasibility in both thin films and nanowires for electronic memories has not been extensively investigated. The synthesis of the chalcogenide nanowires was mainly preformed via a vapor transport process such as vapor-liquid-solid (VLS) growth at a high temperature. However, in this study, IST nanowires as well as thin films were prepared at a low temperature (~ 250 °C) by metal organic chemical vapor deposition(MOCVD) method, which is possible for large area deposition. The IST films and/or nanowires were selectively grown by a control of working pressure at a constant growth temperature by MOCVD. In-Sb-Te NWs will be good candidate materials for high density PRAM applications. And MOCVD system is powerful for applying ultra scale integration cell.

Key Words : In-Sb-Te materials, MOCVD, Chalcogenide nanowires, Phase change memory.

1. Introduction

In-Sb-Te (IST) materials have been applied for phase-change optical data storage devices. IST can secure a reliable threshold voltage in a nano-sized contact dimension. IST also has the advantage of multi-level data storage through a resistance difference that can be attributed to a change in crystal structure.[1,2]

2. Experiment

In this study, In (TMI, $CH_3)_3$, $Sb(iPr,C_3H_7)_3$ and $Te(iPr,C_3H_7)_2$ precursors were used for IST films and/or nanowires. The precursors were chosen due to their compatibility in the MOCVD process where the deposition is controlled by the substrate temperature. The IST thin films and the nanowires were prepared on planar TiAlN(30 nm)/SiO_2(100nm)/Si substrates using a bubbler-type MOCVD.

3. Results and Discussion

InSbTe nanowires can be grown directly by low temperature (~ 250°C) MOCVD technic as a crystalline InSbTe phases. (Fig 1 and 2)

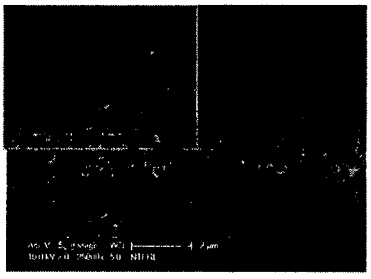

Figure 1. SEM images of InSbTe NWs directly grown by MOCVD.

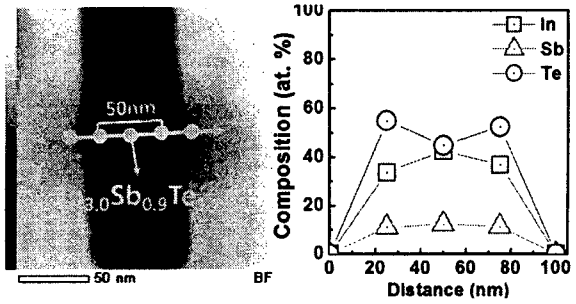

Figure 2. STEM images and composition of InSbTe NWs

4. Conclusions

Phase-change IST crystalline nanowires were successfully synthesized at the low temperature of 250°C by MOCVD. The growth of IST nanowires by MOCVD was mainly governed by high super-saturation, and they were grown under a high working pressure.

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