Switching behavior of $GeCu_2Te_3$ phase change memory cell

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ABSTRACT

A new phase change material with a high thermal stability of amorphous state is needed to obtain a better data retention at a high temperature environment [1,2] and to endure a thermal disturbance between memory cells [3] for phase change random access memory (PCRAM) application in the future. To solve the problem, our group has developed $GeCu_2Te_3$ (GCT) phase change material [1]. GCT has a higher crystallization temperature (230 °C) and a lower melting point (500 °C) than $Ge_2Sb_2Te_5$ (GST), so GCT memory cell is expected to show not only a higher thermal stability but also a lower power consumption than GST memory cell. Moreover, an access speed of GCT memory cell should be comparable to GST memory cell due to a fast crystallization speed of GCT [4]. In addition, GCT memory cell is expected to show long cycle endurance due to a small density change upon phase transition [4]. Recently, we reported that GCT memory cell has a higher resistance contrast than GST memory cell, since a total resistance of memory cell with nm size is dominated by a contact resistivity between a phase change material and an electrode [5]. Although the device operation should be dominated by the contact resistance, the relationship between the device operation of PCRAM and the contact resistance is poorly understood. Therefore, in this study, we investigated the device operation of GCT memory cell and discussed the relationship between the device operation of PCRAM and the contact resistance. A GCT memory device with a W electrode was fabricated by using RF sputtering, photolithography (PL) and focused ion beam (FIB). The device operation of the GCT memory cell is analyzed by a semiconductor device analyzer (B1500A, Keysight) with a pulse generator (16440A and 16445A, Keysight). The current-voltage (*I-V*) characteristics of GCT memory cell showed a rectification behavior in RESET state. Meanwhile, *I-V* characteristics of GCT memory cell showed an Ohmic behavior in SET state. This should be due to the Schottky contacts between amorphous GCT and an electrode. In this presentation, the rectification behavior of Schottky contact between amorphous GCT and W electrode will be mentioned and the ovonic threshold switching (OTS) of GCT memory cell will be also discussed.

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