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Sridhar Chandrasekaran, Firman Mangasa Simanjuntak, Rakesh Aluguri, Tseung-Yuen Tseng

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The impact of TiW barrier layer thickness dependent transition from electro-chemical metallization memory to valence change memory in ZrO_2-based resistive switching random access memory devices

Sridhar Chandrasekaran[1], Firman Mangasa Simanjuntak [2], Rakesh Aluguri[3], Tseung-Yuen Tseng[3,*]

[1] Department of Electrical Engineering and Computer Science, National Chiao Tung University, Hsinchu 30010, Taiwan

[2]WPI-Advanced Institute for Materials Research, Tohoku University, Sendai 980-8577, Japan

[3]Department of Electronics Engineering and Institute of Electronics, National Chiao Tung University, Hsinchu 30010, Taiwan

[*]Corresponding author's email: *tseng@cc.nctu.edu.tw*

Abstract

The effect of TiW metal barrier layer thickness on voltage-current characteristics of the Cu/TiW/ZrO_2/TiN conductive bridge random access memory device was systematically investigated. The change of reset behavior from abrupt decrease to gradual decrease with increasing TiW thickness was observed. Electronic conduction during the forming process was also analyzed to obtain detailed information about the effect of TiW layer thickness on the nature of the conduction phenomenon. The temperature coefficient of resistance of the conductive filament confirms that an electro-chemical metallization (ECM) based conduction was observed in the devices made with a thinner TiW layer. On the other hand, valence change memory (VCM) based conduction was observed with a thick TiW layer. A conduction mechanism is proposed to explain the ECM to VCM conduction transformation phenomenon.

Keywords: Conductive filament; Electro-chemical metallization; valence change memory; switching device; Zirconium dioxide; Titanium tungsten alloy.