**University of Southampton – ECS - Ruomeng Huang -** [**r.huang@soton.ac.uk**](mailto:r.huang@soton.ac.uk)

**The excel file contains raw data for the paper. The detailed description are below:**

**Figure 1** Resistive switching of Ge-Sb-Te phase change memory fabricated by non-aqueous electrodeposition (a) thin film schematic (b) thin film cycling (c) cell schematic (d) cell cycling.

**Figure 2** SEM images and EDX spectra of an electrodeposited Ge-Sb-Te thin film (a and c) and confined cells (b and d).

**Figure 3** (a) Schematic of the electrodeposition setup; (b) Cyclic voltammograms for Ge-Sb-Te electrolytes containing 0, 1, 4, 7 or 10 mM [NBun4][GeCl5] 1 mM [NBun4][SbCl4] and 2 mM [NBun4]2[TeCl6] in dichloromethane containing 0.1 M [NBun4]Cl as the supporting electrolyte.

**Figure 4** SEM images of the as-deposited films on TiN prepared in electrolytes containing (a) 0, (b) 1, (c) 4, (d) 7 or (e) 10 mM [NBun4][GeCl5], 1 mM [NBun4][SbCl4] and 2 mM [NBun4]2[TeCl6] in 0.1 M [NBun4]Cl in CH2Cl2. A Pt gauze and an Ag/AgCl (0.1 M [NBun4]Cl in CH2Cl2) electrode were used as counter and reference electrodes. The deposition potential was held at -1.75 V and a charge of -0.05 C was passed to obtain deposits with a controlled thickness.

**Figure 5** AFM images of (a) sputtered GST and of films deposited in electrolytes containing (b) 1, (c) 4, (d) 7 or (e) 10 mM [NBun4][GeCl5], 1 mM [NBun4][SbCl4] and 2 mM [NBun4]2[TeCl6] in 0.1 M [NBun4]Cl in CH2Cl2. A Pt gauze and an Ag/AgCl (0.1 M [NBun4]Cl in CH2Cl2) electrode were used as counter and reference electrodes. The deposition potential was held at -1.75 V and a charge of -0.05 C was passed to obtain deposits with a controlled thickness.

**Figure 6** Compositions of Ge-Sb-Te (a) films and (b) nanocells in 100 nm confined cells deposited from electrolytes containing 0, 1, 4, 7 or 10 mM [NBun4][GeCl5], 1 mM [NBun4][SbCl4] and 2 mM [NBun4]2[TeCl6] in 0.1 M [NBun4]Cl in CH2Cl2.

**Figure 7** Cross-sectional STEM-EDX on 100nm confined cell Ge-Sb-Te phase change memory prepared from an electrolyte containing 4 mM [NBun4][GeCl5], 1 mM [NBun4][SbCl4] and 2 mM [NBun4]2[TeCl6]. A Pt gauze and an Ag/AgCl (0.1 M [NBun4]Cl in CH2Cl2) electrode were used as counter and reference electrodes. The deposition potential was held at -1.75 V for 10 s.The scale bar is 250nm.

**Figure 8** Design of passive matrix suitable for electrodeposition with lithographically defined working electrode (left) and functional 10x10 and 10x1 passive matrix cell with e-beam lithography confined cells.

**Figure 9** Process flow for the fabrication of a passive memory matrix from electrodeposition. Descriptors of colours and elements are provided in the figure.

**Figure 10** (a) SEM images of the matrix after GST electrodeposition; (b) design of passive matrix suitable for electrodeposition with lithographically defined counter electrode; optical images of functional 10x10 (c) and 1x10 (d) passive matrix cells with e-beam lithography patterned confined cells.

**Figure 11** Resistance of 100nm TiN bottom contact lines/word lines as measured from electrodeposition pad to Ge-Sb-Te matrices across the chip. Extracted resistivity of the TiN word lone is 1.2(1) µΩ m. (b) Resistance of four different 200 nm TiN top contact/bit lines as measured across the Ge-Sb-Te matrix pad. Extracted resistivity of the TiN bit line is 3.2 (2) µΩ m. Four-point probe resistivity of the reactively sputtered TiN is 0.85 µΩ·m.

**Figure 12** Resistance distribution of individual pristine cells in a 1 x 10 array for cells filled with GeSbTe; (b) I-V characteristics of an individual 1000 nm cell in a 1 x 10 array showing resistive switching behaviour.

**Date of data collection: from 2016-2018**

**Information about geographic location of the data collection: University of Southampton**

**Date the file was created: 10/07/18**