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ANDANTE

AI for New Devices And Technologies at the Edge

D2.3 Morphology validation for PCM

Deliverable No.	D2.3	**Due Date**	*30-May-2021*
Type	Report	**Dissemination Level**	*Confidential*
Version	1.0	**Status**	Final
Description	This deliverable aims to provide a morphological validation of the PCM memory cell intended to support three programming level. Morphological validation is based on a novel architecture (fully confined GDS), showing compatibility with different chalcogenide materials.		
Work Package	WP2 – New memory technologies for AI applications.		

Abstract (Published Summary)

In the context of the development of neuromorphic edge AI applications, ST has conceived a modified version of its proprietary embedded Phase Change Memory (ePCM) cell. The concept of rheostatic PCM (RPCM) is introduced in which both GST and the metallic layer are fully confined. A description of the electrical working principle, the detailed process flow to implement it as well as the main technical challenges solved to achieve the target morphology are described.

The integration of these memories has been done into STM 28FDSOI technology on 300mm wafers.

First a model was calibrated to reproduce the electrical and thermal characteristics of the cell. The proposed simulation framework is thus able to correctly reproduce the behaviour of the conventional cell with Ge-GST. This has been a starting point for the analogue cell operation study reported.

The simulation has hence enabled to define the optimal geometrical dimensions of the cell to ensure good reliability results (based on current densities estimation) for both the heater and the conductive (M0) critical dimensions.

Based on this geometry a dedicated test vehicle has been built, composed of an array of 16Mbyte of PCM cells. It will enable the statistical assessment of the intermediate state placement of the cells.

The sequence of process steps as well as their optimization to implement the rheostatic cell has been set-up, using the suitable materials, thicknesses, and morphologies, according to the conventional cell behaviour and the simulation results. During the process development phase additional challenges have been addressed to complement the proof of concept of the rheostatic cell with a robust and defect free silicon sequence (mainly the risk of film delamination).

Following this approach, STC targets to make both the assessment of the elementary single cell behaviour and the statistical analysis based on a very large amount (several millions) of cells. This will enable a faster implementation of demonstrators in the domain of innovative, dense and reliable AI applications.