This project has received funding from the Electronic Components and Systems for European Leadership Joint
Undertaking under grant agreement No 876925

ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

ANDANTE

AI for New Devices And Technologies at the Edge

D2.6 Intrinsic electrical evidence for PCM-based analog cell and 2TIC back-end cell

Deliverable No.	D2.6	**Due Date**	*30-Dec-2022*
Type	Report	**Dissemination Level**	*Confidential*
Version	1.0	**Status**	Final
Description	This deliverable aims to provide electrical evidence of the multilevel resistance state of 1) a new Rheostatic cell and 2) a combination of thin-film transistor and capacitors to create analog devices in the back-end of line (BEOL).		
Work Package	WP2 – New memory technologies for AI applications.		

Abstract (Published Summary)

In the context of the development of neuromorphic edge AI applications, STCrolles and IMEC were exploring and co-integrating novel memory technologies to improve analog Artificial Neural Networks (ANN) and Spiking Neural Networks (SNN).

STCrolles has conceived a modified version of its proprietary embedded Phase Change Memory (ePCM) cell. The concept of rheostatic PCM (RPCM) and a description of the electrical working principle is provided in which both GST and the metallic layer are fully confined. The Morphology of the obtained cell is shown, as well as the electrical characterization. A substantial change in the R(I) characteristic of the PCM cell is demonstrated thanks to this new concept: a change in the slope is shown, opening the way to multilevel programming. Thanks to this behaviour, using an appropriate programming sequence, presence of different resistance states is proven, showing a demonstration of 8 well-separated resistive states. This behaviour opens the way to use this device as weight storing element in SNN based on multiply accumulate architecture.

IMEC combined thin-film transistor (TFT) and capacitors to create analog devices in the back-end of line (BEOL). InGaZnO4-based thin film transistors (IGZO-TFT) have been extensively researched for their application in flat panel displays and sensors. Thanks to their BEOL compatibility and ultra low off currents, they are very promising for neuromorphic computing applications. These devices can be scaled as well as stacked for dense array applications. The IGZO-TFTs can be integrated in 2T0C and 2T1C gain cells to act as weight storing elements with long retention time. In this work, we engineer the stack and the device design to meet the target specifications for machine learning applications. This document reports on the high-temperature performance and multilevel programming in these cells. We also demonstrate multiple accumulate-operations using these gain cells integrated in mini-arrays.