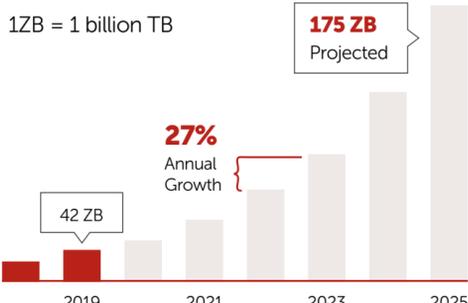


Finding the Sweet Spot in Storage Class Memory

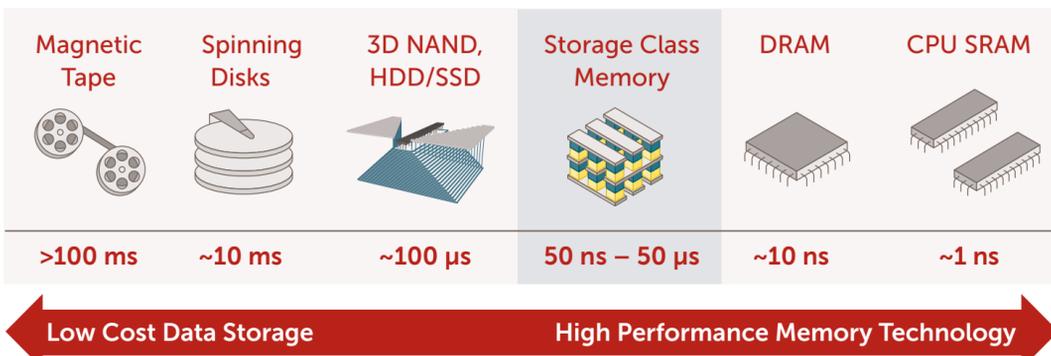
A Data Explosion Calls for Technology Innovation

Every year, 27% more data is produced than the year before, with 42 zettabytes (ZB) of data created in 2019. This trend affects every device that relies on memory storage, from consumer products to enterprise applications that have stringent requirements for data access speed, storage density, and durability.



EXAMINING THE MEMORY TECHNOLOGY SPECTRUM

There is a spectrum of memory technology, from very slow memory tape to today's low-cost, NAND-based solid-state memory, to high-performance, expensive CPU memory.



Storage Class Memory (SCM) occupies a critical middle ground, much more performant than non-volatile NAND flash memory, but not as costly or energy-dependent as volatile memory like DRAM or SRAM.

HITTING THE SWEET SPOT: PHASE-CHANGE MEMORY

Within this SCM category, PCRAM (phase change memory alloy) is in the sweet spot, capable of delivering <20 ns access times, faster than typical SCM and can be just a hair below DRAM in speed performance. PCRAM can enable:



INCREASED DATA ACCESS PERFORMANCE

~1000X that of NAND



HIGHER STORAGE DENSITY

4X higher than DRAM



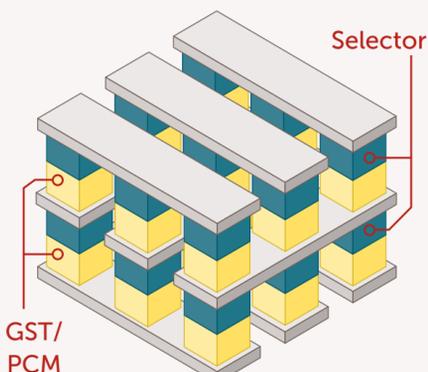
HIGH DURABILITY

1000X or more cycle endurance than NAND

DESIGNING PCRAM FOR SCALE

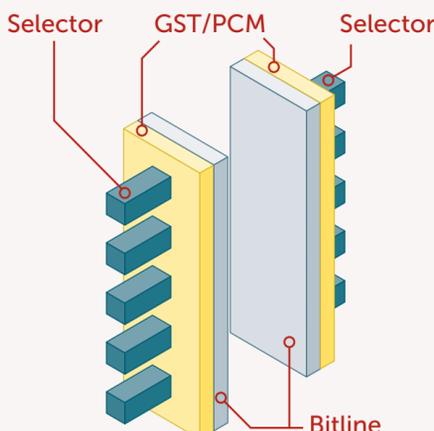
Multiple designs are being explored to develop 3D PCRAM structures with phase change memory (PCM).

CROSS-POINT STACKED 3D STRUCTURE



3D-stacked cross-point architecture is performant, but it must be built layer by layer and may not be cost-effective as it scales.

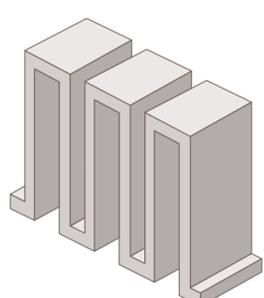
VERTICAL 3D ARRAY STRUCTURE



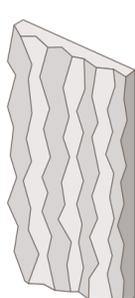
Arranging the PCM cell array vertically like 3D NAND may offer the most benefits in terms of density and lower cost of ownership.

DEPOSITION CHALLENGES AND SOLUTIONS

Phase-change material crystallizes at relatively low temperatures, adding to the deposition challenges brought by high-aspect ratio architecture.



Vertical, high-aspect ratio structures require conformal deposition.

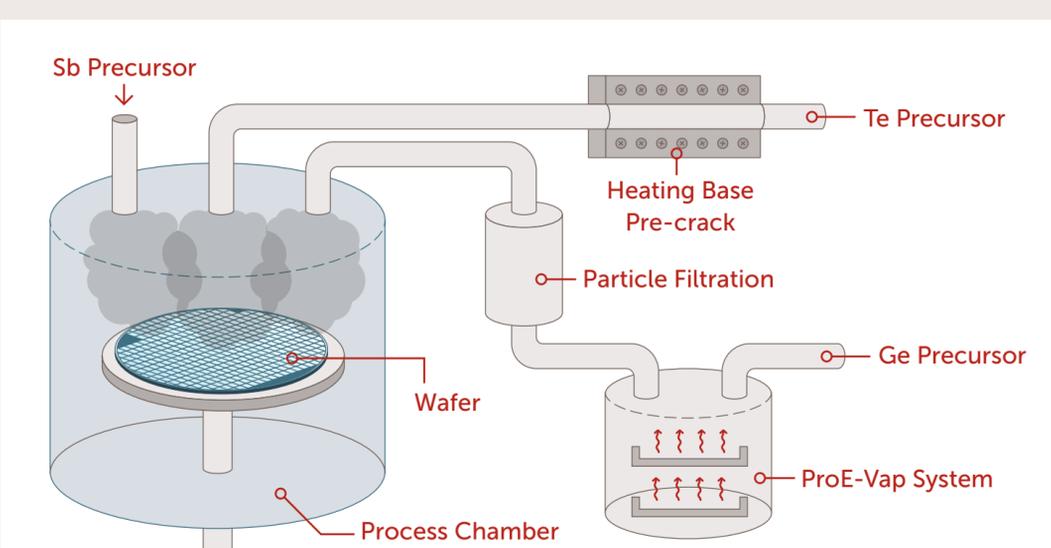


Temperatures >200°C yield rough, crystalline film in deposition.



Temperatures <200°C produce smooth, amorphous film.

In response, Entegris has developed an innovative solid germanium precursor (GEM™) that can be deposited at <180°C. It is a solid precursor that liquefies at 40°C and can be delivered as a vapor using a heated ProE-Vap® system.



ENABLING PHASE CHANGE MEMORY PERFORMANCE

Phase-change materials can play an increasingly important role in storage class memory, filling a critical gap between low-cost and high-performance memory technologies.

To achieve success, the focus needs to be on performance materials, clean material handling, and defect-free material delivery — all of which are enabled through Entegris technology.

Learn More

www.entegris.com/scm