Cerabyte (www.cerabyte.com), founded in 2020, is developing Ceramic Nano Memory, a data storage technology featuring a sputtered deposited extremely durable ceramic nano layer with a broad absorption spectrum, a “grey ceramic”, which allows ultra-fast write with threshold as low as 0.1 nJ per bit. The ceramic is deposited on both sides of a flexible ultra-thin planar substrate with only 100 µm thick foldable glass\(^1\) or 10 µm thick ribbon glass\(^2\) for potential tape development. These substrates and the coating a ceramic nano layers leverage existing display glass production capacities of today 350 million m\(^2\) per year \(^3\). Thus the company expects to achieve media cost below $ 1 per TB by the end of this decade.

Cerabyte ceramic-on-glass sheets use ultra-thin glass as substrate material, which is cut to sheets of 9x9 cm, coated with a 10 nm thin dark ceramic nanolayer comprising only 50-100 atom layers, forming the novel data carrier.

The writing process is using ultra-short laser pulses in combination with off the shelf digital mirror devices (DMD) which is commonly used in video projectors and head-up displays. The combination of the laser with a DMD generates a laser beam matrix which permanently ablates the ceramic nano-layer and writes up to 2 million bits per pulse in parallel at high repetition-rates in the kHz range. This enables future writing speeds of 1+ GB/s with less than 1 W average power which is 3-4 times faster compared to LTO tape or HDD technology.

The reading process uses the same microscope optic, high-speed illumination and an ultra-fast high-resolution image sensor with 500+ frames per second. The decoding of these

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image data into digital data is than performed by parallel processing via FPGA (Field Programmable Gate Array) thus enabling reading speeds of 1+ GB/s, again outperforming HDDs by far. See video of the prototype system – Cerabyte from Vision to Reality

Both reading and writing are carried out across the substrate by scanning the microscope optics using high-speed XY stages kept in focus using a piezo driven auto focus system. This setup allows random access.

Multiple 9 cm by 9 cm Cerabyte sheets are stacked in individual cartridges to minimize volumetric storage volume. Cerabyte uses the external form factor of common magnetic tape cartridges, while media can be retrieved in a random-access regime achieving much shorter time to first byte compared to LTO tape.

Accelerated aging tests between -273 °C to 500 °C indicate potential storage lifetime in the millennia range. Furthermore, the data is not corrupted even when exposed to electromagnetic pluses, UV, or gamma rays.

Cerabyte employs a commercially available library unit utilizing a remote write architecture. The library will locate the and retrieve the cartridge, then unload and unstack the substrates for positioning the addressed substrate in the optical unit.
Cerabyte – Ceramic Nano Memory

The Cerabyte prototype system with a single write & read head unit achieves 5 MB/s write/read speeds. The first demo system for archiving customers is scheduled to be available for remote testing in 2024 with 100 MB/s write/read speeds and a capacity of 1 PB/rack with up to 10 robotic library racks. In 2025 a 20 rack system for cloud data centers will be launched with 1 GB/s write/read speeds and a capacity of 10 PB/rack, which increase over time and will achieve capacities attractive for hyperscalers by end of the decade.

The visionary roadmap foresees the usage of high-speed particle beam matrix beyond 2030, which will significantly decrease the nano-layer size reaching storage capacities in the exabyte range while boosting writing and reading speeds significantly.

The roadmap until 2030 and beyond is strengthened by a comprehensive intellectual property (IP) portfolio, comprising an extensive collection of international patents and patent applications covering storage media, writing/reading devices and high-density matrix formats underpin the company’s commitment to technological leadership and innovation of cold data storage. The patent portfolio covers 80% of global GDP, 85% of global data storage infrastructure, 67% of smartphone penetration and 49% of global population.