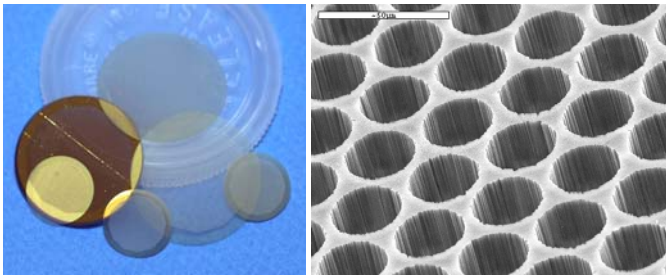
CERAMIC MICROCHANNEL PLATES

TECHNOLOGY PROFILE

OVERVIEW

Microchannel Plates (MCPs) are compact solid state electron multipliers used in low-light and night vision systems, scientific detectors and biomedical imaging. MCPs currently in the marketplace are produced using glass fiber technology, which is limited in meeting the increasing cost and performance demands of existing and emerging applications.

Synkera's patent-pending technology provides a novel platform for fabrication of high-resolution MCPs from micromachined alumina ceramic. This technology has a potential to overcome many limitations of glass MCPs and to enable inexpensive mass-production of Ceramic MCPs (cMCPs) with unique features and user benefits: high resolution, high count rate capabilities, better yield and reproducibility, high temperature capabilities, and long lifetime.



Ceramic MCP prototypes (1" and ½" size) and the close-up of the channels micromachined in ceramic.

Synkera has demonstrated the feasibility of the technology, validated critical processing steps and fabricated preliminary Ceramic MCP prototypes. At this time, we are actively seeking additional funding and partnership opportunities to support comprehensive development.

FEATURES AND PERFORMANCE

Channel Size / Shape / Registration

Channels diameter as low as 2-3 μm and aspect ratio (channel length / diameter) of 1:40 have been demonstrated. Further increasing resolution while scaling the process to larger areas is the goal of current development efforts. Control of the channel shape was validated with round and square channels. Precise channel registration is a default feature of micromachined cMCPs.

Open Area Ratio

Round channels with open area ratio of up to 80% have been micromachined. Hexagonal channels can yield cMCPs with an open area up to 90%.

Size / Format

Prototypes of 25 mm circular cMCP are currently under development. Larger sizes (up to 150 mm) and various formats are supported by Synkera's Ceramic MEMS capabilities. Non-planar cMCPs are also potentially feasible, which could benefit applications such as lobster-eye optics.

Channel Modification

Automated batch processes have been developed for precision modification of the bulk resistance of cMCP substrates and conformal deposition of secondary emission coatings onto the channel walls. This capability enables versatile engineering of application-specific cMCPs.

Thermal and Mechanical Stability

Synkera's cMCPs are fabricated from refractory ceramic and withstand processing temperatures as high as 900-1000°C without any structural damage. It opens up new opportunities for improving MCP performance, such as integration of advanced photocathodes directly onto the MCP surface as well as degassing by annealing prior to sealing.

Possibility of Channel Bias

Preliminary validation of a new method for creating cMCPs with biased and/or curved channels was performed, opening the opportunity for targeting a broader range of applications.

Manufacturability / Cost

Fabrication of cMCPs involves processes similar to conventional microfabrication and is scalable for large production volumes. It supports low turn-around time, high degree of automation, high yield, reproducibility and economies of scale. Estimated production cost is significantly below of that for glass MCPs

Performance

Preliminary evaluation of the early prototypes exhibited sustainable electron amplification, substantial gain and excellent resistance to dielectric breakdown (up to 1000V for 50 μm thick MCPs). cMCPs are also significantly more mechanically robust compared to Si or glass MCPs.

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April 2010

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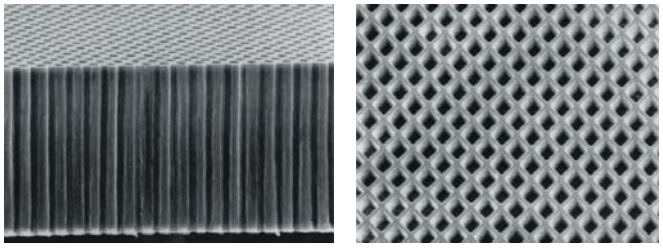
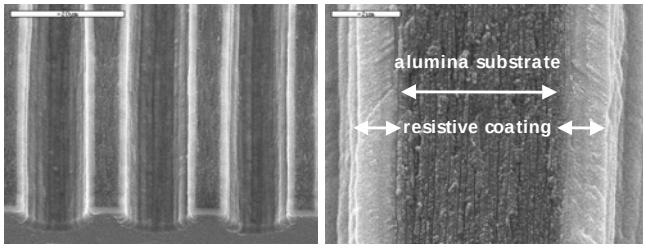
USER BENEFITS

Synkera's cMCP technology could bring significant end user benefits. Many of these benefits are unique to micromachined ceramic and are unavailable with competitive technologies:

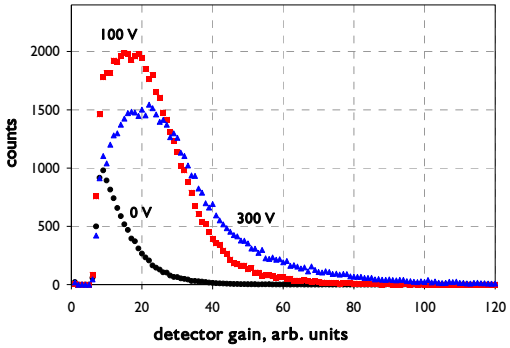
- Increased spatial and temporal resolution.
- Improved image quality due to channel registration.
- Significantly better mechanical robustness and reliability.
- Improved signal-to-noise ratio, dynamic range, local and global count rate capabilities via integration of advanced photocathodes and reducing charge saturation.
- Better stability and longer high count lifetime by suppressing electromigration caused degradation.
- Lower cost for the product with comparable features.
- Enables novel products and application.



Ceramic MCP substrates with round (left, 3 μm) and square channels (right).



Cross-section of cMCP with conformal resistive/emissive coating after 900°C annealing.



Typical pulse height distribution for cMCP at different bias. (cMCP in front of a stack of two glass MCPs at 1500V)

APPLICATIONS

Ceramic MCPs can enable the next generation of image intensifiers and detectors with lower cost and/or better performance for a number of applications:

- Image amplifiers for low- and night-vision devices (goggles, binoculars, and scopes) for military, homeland security and law enforcement users.
- Low and night vision for civil aviation, vision correction and recreational uses.
- Detectors for biomedical imaging, such as β-radiography, luminescence and fluorescence microscopy.
- Detectors for scientific instrumentation, such as electron, ion and mass spectroscopy, electron microscopy, high energy physics research.
- Particle and photon detectors for IR, x-ray and gamma-ray space and ground astronomy.
- Detectors for satellite mapping and surveillance.
- Numerous spin-off applications ob blank ceramic microcapillary plates.

CURRENT STATUS

The feasibility of this technology has been successfully demonstrated. Current development efforts include:

- Reliable fabrication of sub-5 μm channels with aspect ratio of up to 1:60 and maximized open area ratio.
- Larger area processing to enable operational prototypes of 25 mm and greater size
- Demonstrating cMCP substrates with "biased" channels.

Our near-term target is to develop and qualify operational prototypes of low-cost microcapillary plates and cMCPs with performance comparable with existing glass-based products for drop-in replacement or for new high volume applications.

PARTNERSHIP DEVELOPMENT

Joint development partnerships are being sought to further develop the featured technology for specific applications. Areas of interest include application development guidance and prototype evaluation, followed by integration into the image intensifier tubes and introduction to the end customer. We are also seeking partners for spin-off applications of ceramic microcapillary plates. If you would like to discuss this further or need additional information, please contact:

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