OPTOSCRIBE

Pioneering 3D photonic integrated circuits

HIGH PERFORMANCE, MONOLITHIC 3D GLASS STRUCTURES FOR HARSH ENVIRONMENTS

www.optoscribe.com

For optical systems designers, the co-efficient of thermal expansion (CTE) mismatches can cause headaches when developing and qualifying products over the full temperature ranges required for consumer and industrial applications. Typically, products need to demonstrate endurance over -40˚C to 85˚C, under high humidity with both steady state and cyclic temperature profiles. By using assemblies and alignment structures well thermally matched to optical fibers, one of the potential failure mechanisms during qualification can be reduced or mitigated.

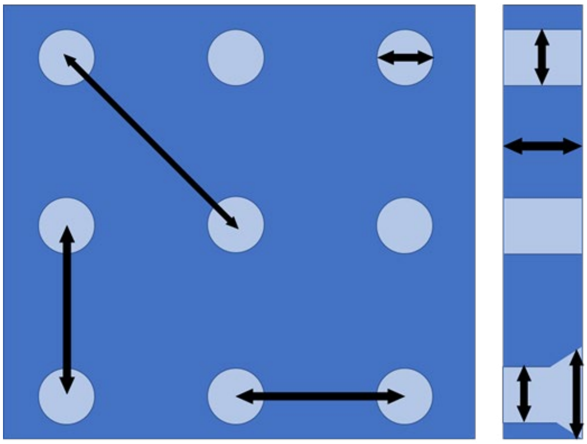

Figure 1: *Flexibility across multiple design parameters*

The main advantage of the glass-based OptoArray™ product family over both silicon and ceramics-based solutions is the sheer design breadth and flexibility available to the systems designer. This, along with short cycle times, allows rapid iteration at the design/development stage. A second, complementary advantage is that the OptoArray™ product is chemically and mechanically well matched to many of the key fundamental parameters for fiber optics, mitigating somewhat potential failure mechanisms when progressing through a qualification program to production.

In this White Paper, we present some key results highlighting the mechanical integrity of the OptoArray™ product over a set of harsh environmental conditions typical to those seen during a full qualification program. Basing the tests on multi-mode fiber structures widely used within the optics community, arrays of holes with a diameter of 140μm ± 2μm fabricated in borosilicate glass were investigated.

Using a standard 100 cycle temperature test, oscillating between -40˚C and 85˚C, we demonstrated that hole structures survive temperature changes of up to 10˚C / min. Over 4,000 holes were tested with no evidence of mechanical degradation or cracking. Figure 2 (a) shows an image of both the hole array and the device edge after 100 temperature cycles with a sample temperature profile shown in (b).

Figure 2a: *Example of holes designed for optical fiber in a borosilicate glass after 100 cycles of temperature testing*

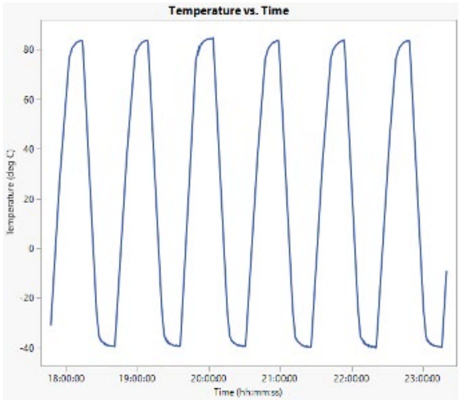

Figure 2b: *Representative temperature cycle.*

In addition, we were keen to understand how the structures performed under very harsh environmental conditions. Using highly accelerated stress conditions (HAST), the more standard Telcordia damp heat endurance test of 1,000hrs of 85˚C at 85% RH was replicated over a 96hr period. Testing was conducted at a temperature of 130˚C with a humidity of 85% and pressure of 0.175MPa for a duration of 96hrs. Over 3,000 holes were tested in this experiment and no degradation or cracking observed. Figure 3 shows a representative hole array after the full 96hrs of testing.

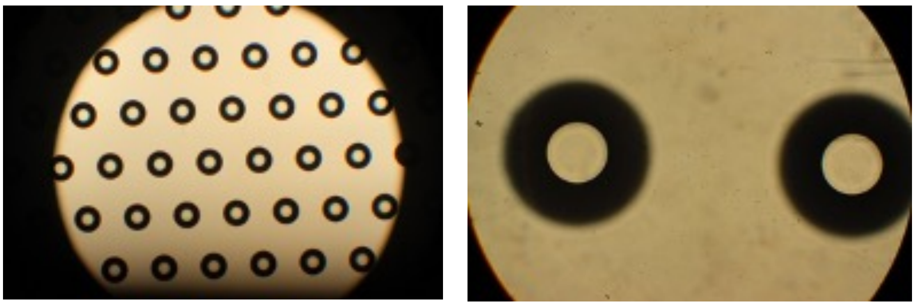

Figure 3a: *Examples of holes designed for optical fiber in a borosilicate glass after 96hrs of HAST, (a) low magnification and (b) high magnification.*

The investigations conducted by Optoscribe show that geometries commonly used within the OptoArray™ product family are mechanically robust, showing no evidence of cracking during harsh environmental testing. Given that the products are based on standard glass technology and fully compatible with silica fiber optics, these results can be used to give a level of confidence to optical systems designers when developing new products for extreme environments.

OPTOSCRIBE
Pioneering 3D photonic integrated circuits

For further information please contact us, details below

Optoscribe Limited
Rosebank Technology Park
Rosebank Road
Livingston
EH54 7EJ
United Kingdom

T: +44 (0) 1506 536000
E: sales@optoscribe.com
W: www.optoscribe.com