PROCESSING APEX™ GLASS

(Updated 8-4-11)

Life BioScience Inc. (LBSI) offers custom micro-fabrication services using APEX™ Glass; however, producing microstructures on your own is straightforward. This document describes processes and equipment we have found to work well for many projects, but we want to acknowledge that each application is unique. Thus, this information is provided as a service to technically proficient users and no warranty, express or implied, is provided.

1. BEFORE YOU GET STARTED:

1.1 LBSI RECOMMENDED EQUIPMENT:

1.1.1. LIGHT SOURCE: In addition to standard flood UV systems, a variety of high-energy deep and mid-UV lasers may be used. The recommended wave length is 310nm (±25nm).

1.1.2. MASK: Quartz-chrome masks are highly recommended.

1.1.3. FURNACE: Capable of sustaining >500C.

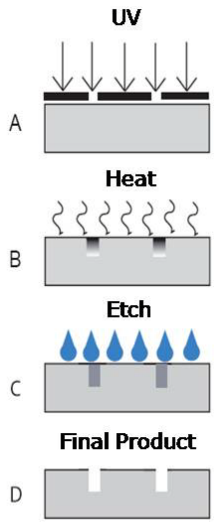
1.1.4. OTHER:

1.1.4.1 Smooth (preferably polished), fused quartz substrates (available through Technical Glass Products (TGP)). We recommend substrates that are 6" x 6" x 0.25" in size.

1.1.4.2 Traycoat A Aerosol (available through ZYP Coatings).

2. TECHNICAL INFORMATION:

2.1 Processing of LBSI's APEX™ Glass is performed using a simple process:

2.1.1. Step A - EXPOSE 2.1.2. Step B – BAKE 2.1.3. Step C – ETCH	 Figure 1.

2.2 LBSI's APEX™ Glass is a photo-structurable glass where areas exposed to 310nm mid-ultraviolet light are transformed into a ceramic during a simple bake process.

2.2.1 The resultant ceramic is 30 times more soluble in hydrofluoric acid.

2.2.2 The increased solubility of the exposed regions allows very small feature sizes (<20µm) and high aspect features (ratios >50:1).

2.2.3 Processing of LBSI's APEX™ Glass is performed using a simple 3-step process. Table 1 below gives process parameters for the two standard thicknesses of the APEX™ Glass: 0.5mm and 1.0mm.

3. THE PROCESS:

3.1 ***EXPOSE***:

3.1.1 Users may expose/pattern APEX™ Glass wafers using either of two methods:

3.1.1.1 METHOD 1: Using direct contact with a quartz-chrome mask;

OR

3.1.1.2 METHOD 2: Users who do not have a quartz-chrome mask may spin-coat and pattern positive or negative photoresist onto the glass and then expose the patterned wafer to mid-UV light. Different amounts of exposure will lead to the formation of different amounts of ceramic.

3.1.2 OTHER: In addition to standard flood UV systems, APEX™ Glass may be exposed using a variety of high-energy deep and mid-UV lasers.

3.2 ***BAKE***: The baking event consists of two steps:

3.2.1 STEP 1: The temperature is raised to 500C (Table 1 below) and held there to allow the photo-activators, created during the exposure process, to migrate together forming nano-clusters.

3.2.2 STEP 2: The temperature is raised to a second temperature and held to induce ceramic nucleation within the glass matrix around the previously formed nano-clusters. During this second step of the baking process, the exposed regions are converted into a brown ceramic. While baking processes may be varied, it is recommended that initial baking protocols stay close to the bake schedule given in Table 1 below.

3.2.3 NOTE: All APEX™ Glass parts should be baked on smooth (preferably polished), fused quartz substrates (available at Technical Glass Products (TGP)). The APEX™ Glass wafers or coupons should be laid down flat and sandwiched between the two fused quartz plates that have been coated on the sides that come in contact with the APEX™ Glass. We recommend using Traycoat A Aerosol (available at ZYP Coatings) to coat the fused quartz substrates. The APEX™ Glass wafer is sandwiched lying down to prevent any bowing of the glass during the bake process.

3.3 ***ETCH***:

3.3.1 In this final step, the wafer is etched in a hydrofluoric solution creating Through Glass Vias (TGVs), wells, or other desired features.[1] The desired structure height/depth can be controlled by varying etch concentrations and etch times.

3.3.2 For initial processing protocols, and as a good starting point, we suggest the "water:HF" mixtures identified in Step #4 of Table 1 below.

Step #	Process	Metric	Process Control
1	Exposure	10.0-24.0 Joules/cm^2	At 310nm
2	Bake – 1	500C for 75 minutes	6C/min ramp rate
3	Bake – 2	575C for 75 minutes	3C/min ramp rate
4	Etch	10:1 mix (Water:49% HF)	In ultrasonic bath

Table 1 - Processing 0.5mm and 1.0mm Thick Glass

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[1] **HYDROFLUORIC ACID IS EXTREMELY CORROSIVE AND A CONTACT POISON. IT SHOULD BE HANDLED WITH EXTREME CARE ONLY BY EXPERIENCED PERSONNEL WITH PROPER SAFETY EQUIPMENT.**