Focused On Manufacturing:
Glass Micro Machining

OVERCOMING THE CHALLENGES OF MACHINING SMALL FEATURES IN GLASS

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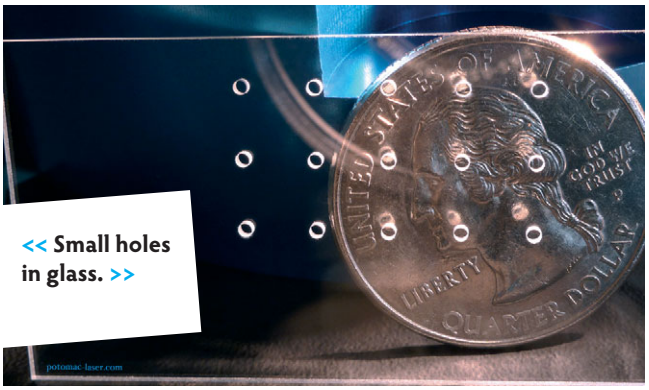
The unique properties of glass make it the optimal material choice for many applications. The semiconductor and micro electronics idustries utilise glass due to its inert and optical characteristics. Biologically inactive, it is commonly used in the biochemistry and medical fields, particularly in the manufacture of micro fluidic devices. So, while glass is often a strong material choice, the machining of glass for those applications poses a set of unique challenges.

The demands of machining glass are complicated further by the wide variation in glass characteristics. There are many types of glass, including fused silica, borosilicate glass and quartz, each with different properties. Consequently, there isn't just one solution for micro machining glass. At Potomac Photonics, we found that we needed to integrate a number of micro manufacturing technologies to discover the most appropriate technology to use for various applications.

As described in the Society of Manufacturing Engineers Knowledge Base, glass is very fragile and manufacturing processes must take into account the possibility of cracking and breakage. While micro CNC machining is a good process for thicker glass parts, we find that thin glass can only be successfully machined with the non-contact material interaction of laser light. This is especially true for glass tubes. Walls of glass tubes are often so thin that cutting through to the other side is a problem with mechanical processes.

However, not just any laser can successfully machine glass. Machining will only occur if the material absorption is matched to the laser wavelength. While there is variation between the types of glass, most glass absorbs somewhere in the ultraviolet wavelengths. This limited absorption spectrum also makes glass a great substrate for conductive coatings or films where precise patterning is desired without damaging the glass.



<< Small holes in glass. >>

<< Micro hole drilling. >>

We are also able to control depth of the cut or hole by the number of laser pulses delivered to the surface. With UV lasers, this pulse control allows us to create very precise blind holes or wells in glass surfaces. In addition, lasers are also excellent tools for precision marking of glass for applications such as putting fiduciary marks on parts, or batch control codes.

A number of the challenges in working with glass relate to auxiliary requirements, beyond the actual machining. Fixturing is a particular problem, especially with thin glass. Due to its fragile nature, fixturing has to be designed to be robust enough to hold the glass firmly, yet not introduce uneven stresses that can lead to undesired damage (eg. cracking, chip-out, etc.) of the glass substrate. Another challenge in processing glass is cleaning. We've developed sophisticated post-process cleaning to eliminate any debris generated in the micro machining.

Potomac's extensive expertise in glass micro machining has actually expedited research being done in the Biochemistry and Molecular Genetics Department at the University of Colorado School of Medicine in Denver. Dr. Jay Hesselberth's cancer research utilises a micro fluidic glass device with ports to put fluid through the glass.

As research technician Kerri York remembers: "Micro machining the glass slides was the bottleneck in our project. We had built an apparatus and needed the parts to fit exactly. So consistency of hole alignment and size was crucial." Using a diamond bit mechanical tool, Ms. York found that the breakage of slides yielded few useable parts. She discovered Potomac online, and comments that "parts from Potomac were perfect from the start. We're scientists, and our expertise is not in fabrication. So it's so much easier not to have to spend time on the machining. Prior to finding Potomac it took six months to get a result, and now we're doing that same process in a month. Potomac's glass micro machining was a saving grace for the project."

It's gratifying that Potomac has been able to develop a set of skills for micro machining glass that can propel important projects forward, especially in cancer research innovation.

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