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Value the potential of glass

SACE combines thermal and chemical processes in order to create a productive and precise technology for micromachining of glass. We spoke with Professor Rolf Wüthrich, who has developed with his team the SACE process at Concordia University in Montreal.

Mikroproduktion: You've worked with your team for over ten years intensively on the SACE technology. What distinguishes the process?
Wüthrich: As the name ›Spark Assisted Chemical Engraving‹ suggests, we deal with a process that is a combination of chemical and thermal mechanisms. At high current density, the thermal process dominates and a high material removal rate with a relatively rough surface is obtained. At low current density the machined contour is very precise, and the surface finishes good with Ra values reaching approximately 1 micron. As the process etches silicon-oxide, it is also suitable for other materials than glass, such as quartz, silicon-oxide or pure silicon.

Mikroproduktion: What obstacles were on the road to industrialization?
Wüthrich: The core problem was to control reproducibly the formation of a thin plasma film during electrolysis. Through the electrical parameters and the kinematics of tool motion we can master the process well. The method to control the spark gap is our expertise. Other conditions for acceptance in industrial applications are also productivity and automation. For this, Posalux has a large variety of practical high precision machines. In this way, we are absolutely competitive, even compared to established techniques such as laser ablation or etching.

Mikroproduktion: What are the advantages of SACE over other glass-processing operations?
Wüthrich: Thermal, mechanical and chemical processes all have their advantages and disadvantages. Thermal processes, such as laser ablation, are very fast. However, often heat-related damage and deposits of material arise. Mechanical processes are also relatively fast, but due to the mechanical force are prone to the formation of microcracks. Chemical methods are actually best suited for glass; however, they are very slow and only reach a low aspect ratio. In addition, highly toxic chemicals are used. SACE is a hybrid process which combines the advantages of thermal and chemical processes, thus achieving high material removal rates with high precision. Tool wear is extremely low. A workpiece processed by SACE does not show any thermal damage and burrs which is an important benefit for downstream processes such as bonding. Moreover, SACE uses common alkaline solutions (e.g. sodium hydroxide) as electrolyte and is clean-room compatible.

Image: Mikroproduktion

Mikroproduktion: What material removal rate can be achieved?
Wüthrich: For the processing speed in micro-fluidics applications 700 microns appears as a magic number, as the substrates often have these dimensions. Sandblasting can machine a material thickness of 700 microns within 30 minutes, however, with many holes simultaneously. To be competitive, you have to drill a 700 microns deep hole in less than 10 s which we already succeed. Depending on whether the physical or the chemical process dominates, we can also adjust the surface quality. With SACE you can do both: quickly cut a structure and afterwards polish it. The maximum speed during the rough machining is, for example, at 20 mm/min at a depth of cut of 200 to 250 microns. The depth can be adjusted very precisely to 10 to 15 microns. The radius at the bottom of the hole is lower than 10 to 20 microns and very sharp, which in comparison to classical etching has advantages.


Professor Dr. Rolf Wüthrich, responsible for the development of the SACE process and its industrialization at Posalux SA

Mikroproduktion: You mentioned micro-fluidics as a possible application. Where do you see further applications?
Wüthrich: With SACE, the potential of the high performance material glass can be much better utilized, than it was in the past. We can mention for example, sensor systems, optoelectronics or drilling Through Glass Vias in optical PCBs. When used for prototyping SACE allows a direct route from the drawing to the end product. In the production of security features, SACE could also be used, for example by engraving of unique and none reproducible identification marks. ■