Electro-Chemical Discharge Machining

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Mission Statement:

•Explore a new method of micro-machining, electro-chemical discharge machining (ECDM), to create robust and inexpensive micro-scale fluidic channels for bio-analytical devices.

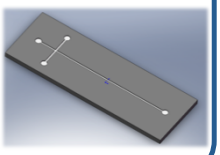


Figure 1. glass wafer

ECDM Process:

•ECDM uses strong electric fields and chemical reactions to etch glass substrates. A DC voltage is applied between the tool and counter electrode with the tool located a few micrometers above the target etch site.

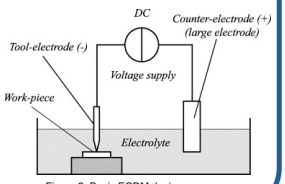


Figure 2. Basic ECDM design

Research Methods:

•Used existing ECDM apparatus to perform etching experiments and improve off that platform

•Developed new basic design of apparatus using Computer Aided Design Program: Solid Works

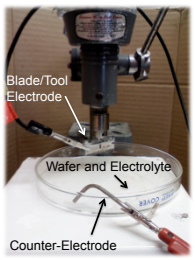
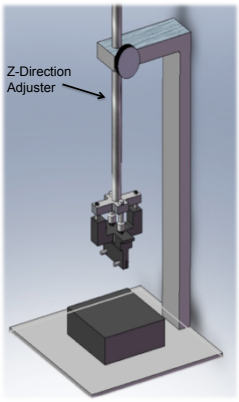


Figure 3. Previous ECDM Design by Jess Sustarich

•Created new, robust mechanism to hold a razor blade as the tool electrode and added adjusters to have full control of the razor blade positioning

•Used Solid Works to create engineering drawings for the machining of all the parts

First ECDM Design:



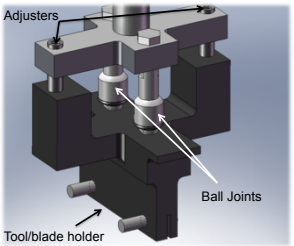
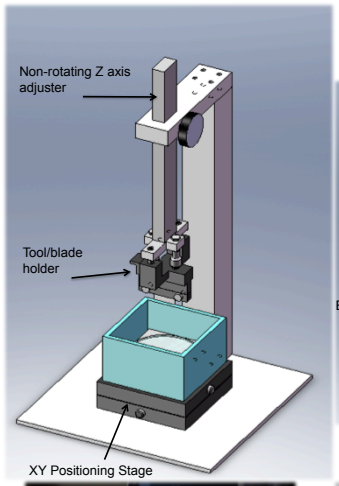
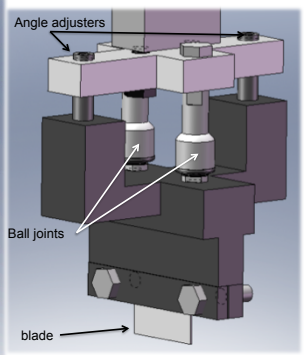
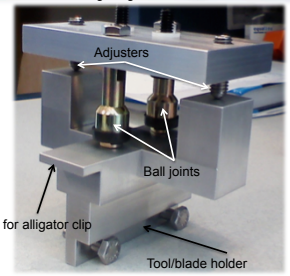


Figure 4. First Solid Works design whole (top), Close-up tool holder/adjuster (right)

Final ECDM Design:







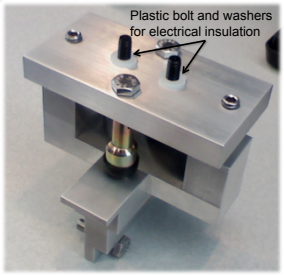


Figure 5. Final whole design (top left), close-up of final tool-holder (top right), Machining Progress (bottom left and right)

Conclusion:

•Preliminary experiments have shown that ECDM with razorblade tool electrodes can etch channel-like features on glass substrate. It produced unwanted features as well (figure 6).

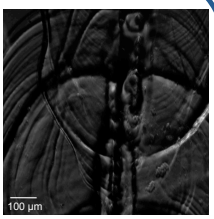


Figure 6. first experimented wafer, 80 Volts

•The new design should give isolated control and should enable repeatable etching

•Learned Solid Works basics and went through the design and building process

Future Work:

•We will use the new ECDM platform to perform experiments to etch well defined and repeatable micro channels

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Dr. Sumita Pennathur, UCSB Nanolab, COE Machine Shop, Daniel Kim, Brett Kagy

References:
[1] "Machining of non-conducting materials using electrochemical discharge phenomenon"—an overview. R. Wüthrich, V. Fascio. 16 November 2004.