Current Application of MEMS in Neural Implants

Current research in MEMS involving neural implants is limited to fabrication of device arrays of micro-probes, for example using LIQ technologies [1]. These technologies are limited to static sensing and probing of neurons - if a micro needle is not in contact with the target neuron site, it is disregarded and left in place. While this plan of attack retains device complexity, the long-term damage and effects are unknown.

By gaining the capability to activate individual probes in the array, unused probes can be removed and other probes can be periodically shifted, allowing regeneration of the neural tissue. We believe it may be possible to build an individually addressable array of micro probes based on the current, mature technology of Microshutter Arrays.

Microshutters project JWS [2]

Micro Electro-Mechanical System (MEMS) microshutter arrays are being developed at NASA Goddard Space Flight Center for use as a 3-D randomly addressable field selector on the James Webb Space Telescope (JWST). Each microshutter has a hinge on one side, and includes a silicon nitride membrane providing the spring to close the shutter when actuating forces are removed. Magnetic cobalt iron straps are coated on the upper face of each microshutter element. In use, a magnet is positioned underneath the array to first open all of the microshutters simultaneously while the magnet is removed to enable imaging. Elements that need to remain open are kept that way by computer-controlled voltages that can be turned on and off selectively for each element in the grid. Shutters are actuated by a magnetic force (0.2 – 0.3 T) and latched using an electromechanical force.

There are many challenges to modify current shutter arrays. For example: 1) The implant must work in electro-conductive liquids, so insulating layers must be bomb proof; 2) current actuation of shutters requires large magnets or electric field. Possible solutions include implanted electromagnets, application of a strong electric field, a large external magnetic field combined with electrical addressing or modification of arrays to reduce actuation force. 2) Individual pins must be thin to be noninvasive, but strong enough to withstand actuation and neural stimulation.

References