Microfabricated XY stage-needle structure for cellular delivery and surgery

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There has been an increasing interest in the last decade towards cellular manipulation for drug delivery, gene therapy, intracytoplasmic sperm injection (ICSI) among others for drug discovery and research and for a deeper understanding of human development and disease. While manual microinjection using conventional glass pipettes remain to be the most widely used technique for cellular delivery, it has a very low throughput rate coupled with increased human fatigue. Albeit alternative contact and non-contact microinjection techniques have been developed including viral vectors, electroporation, liposomal carriers, laser trapping among others, each of them has several short-comings thus making them less attractive for cellular injection.

This paper reports on our initiative to develop an integrated micro XY stage-needle structured assembly for injecting foreign substances like proteins, nucleic acids, DNA, Quantum Dots among others into the parallel arrays of cells with a high throughput rate and flexibility. We present the design, simulation and fabrication process of the MEMS device. We also show the experimental results of the effect that process parameters have on the device geometry.