IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project title: *Monomer layer preparation using substrate motion (vibrations): Simulation and experiments*

Project number: IMURA0105
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Research Academy theme: *Advanced computational engineering, simulation and manufacture*

The research problem

Monomer (photoresist) layer preparation for semiconductor based manufacturing processes is traditionally done by spinning process. However, this process cannot be utilized in the fabrication of 3D microcomponents using Microstereolithography (see schematic in Fig). Liquid layer with controlled liquid thickness can be obtained in MSL by moving the z-stage (or by vibrating it). However unlike spinning process interaction of moving/vibrating substrate with thin liquid layer is not understood enough to develop such a layer preparation system. Understanding of this process will help create much better microstructures in MEMS by using MSL process. Computer simulations of the process of liquid layer formation with moving/vibrating substrate have been hampered by the lack of an efficient numerical method that can simultaneously handle all the complexities of gravity, surface tension, fluid flow, surface wettability, *and* substrate motion.

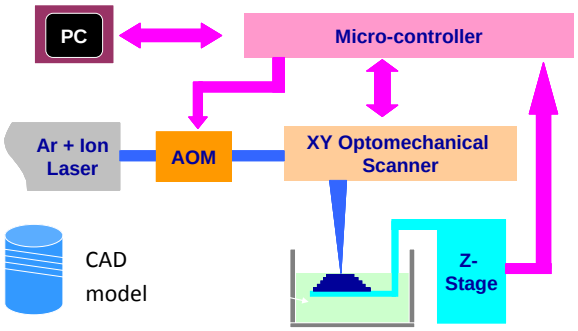

Fig Process of fabrication of microcomponent using microstereolithography: XY scanner scans the laser beam on surface of photopolymer on substrate attached to z stage (according to CAD model shown). After one layer Is formed z-stage moves to get another layer of liquid on the top of previously formed layer. The process continues upto several tens of layers.

Project aims

Our central goals: first to develop using existing techniques a method to predict thickness of free layer of monomer with slow motions to substrate and verify the results experimentally. With the insights developed into the phenomenon, next to develop new experiments to study and understand effects of fast substrate motion/vibrations to develop thinner layers or layers with stationary pattern for further fabrication. Further to support these results with numerical solutions. A state-of-the art clean room facility with novel patented microstereolithography system is available at Dept of Mech Engg at IIT Bombay for the experimental part of work.

Expected outcomes

The project is expected to solve the problem of preparing thin layers for the microstereolithography process thereby enhancing the resolution of the fabricated components and thus getting better microstructures for various MEMS applications.

This Project is an ideal stepping-stone for a rewarding academic or industrial career in micro and nanotechnology and will provide in-depth training in numerical methods, modern simulation techniques, experimental techniques involving fluid layer motions and vibrations, and MEMS. There will be an opportunity for being a part of a startup company and writing patents.