

Development of Eco-friendly Process Technology with Polymer

Masaaki Amikura, Dzung Viet DAO, Koichi Nakamura and Ryo Ota

Keywords: polymer MEMS, comb-drive actuator, imprint

Abstract

◆ Polymer MEMS is a potential technique for eco-friendly devices. We have developed fabrication process of PMMA comb-drive actuator utilizing imprinting methods. The vertical comb actuator was operated well and the mirror plate could rotate about 10 degrees at 100V@300Hz applied consecutively.

Introduction

◆Development of the fabrication process with nano-imprinting method and the simulation techniques, in order to establish the future polymer MEMS device technology.

◆Problem extraction from device products of the polymer MEMS fabrication process, with respect to driving voltage, reflectivity, surface roughness, and biocompatibility.

Methods

◆Fabrication of PMMA comb-drive actuator

Driving voltage : $\leq 30V$

Reflectivity : $\geq 90\%$

Surface roughness : $\leq 100nm$

◆Fabrication of Ni metal mold

◆Reliability test

Results

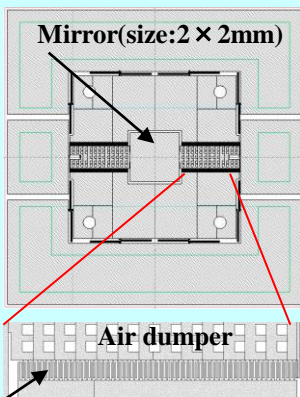


Fig. 1. Structure of micro mirror actuator

The comb-drive micro actuator structures are formed on PMMA plate by silicon mold or metal mold.

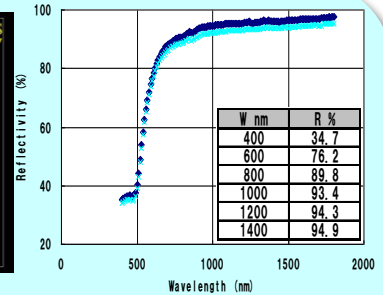
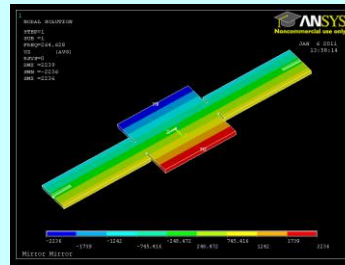


Fig. 2. Simulation of comb-drive actuator and reflectivity of Au(200nm) on PMMA.

The vertical comb actuator was operated well and the mirror plate could rotate about 10 degrees at 100V@300Hz applied consecutively to the left and right actuators at two edges of the beams. And reflectivity of micro mirror was 93.4% at 1000nm.

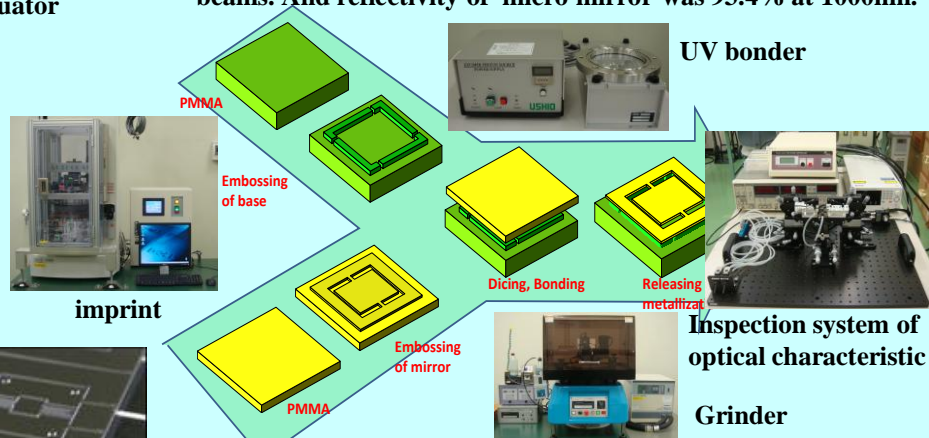


Fig. 3. 4inches fabrication line of polymer MEMS

Summary

- (i) Having finished designing comb-drive actuator, we are producing polymer MEMS using Si Mold.
- (ii) Examine the structure of the actuator when the driving voltage reaches 30V and make a trial product.

References

Satoshi Amaya, Dzung Viet Dao and Susumu Sugiyama, "Development of Monolithic PMMA Comb-drive Micro Actuator Utilizing Hot Embossing and Ultra-precision Machining" (IEEE MEMS2009)