THERMO-MECHANICAL BEHAVIOR OF A MICROMIRROR FOR LASER-TO-FIBER ACTIVE ALIGNMENT

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A laser-to-fiber active alignment is commonly used in the manufacturing of optoelectronic modules. The current approach uses a precision robot to move the fiber for the alignment. The robot with a sub-μm resolution is expensive. The fixture welded to fix the position of the fiber is in the order of mm; its thermal shrinkage after welding is always a problem during manufacturing. As a result, MEMS (Micro-Electro-Mechanical Systems)-based micro-mirror is a promising device; it steers laser beam for active alignment without the precision robot and the fixture. Beam steering using a mico-mirror has been demonstrated before, but fixing the mirror after the alignment is not well understood [1].

In this study, we will present a novel micro-mirror design using a bimorph plate with tethers. The bimorph is pre-stressed in the room temperature; it carries a micro-mirror. The tethers are arranged in a matrix in a plane on the bimorph to restrain the deformation of the bimorph. Breaking a tether by Joule heating generated by an electrical current could change the deformation of the bimorph. It would adjust the mirror position and orientation for precision alignment. With a large number of tethers arranged two-dimensionally, we can reach an optimum alignment after breaking a selected group of tethers. The deformation w.r.t. tethers to be broken is a thermo-mechanical problem. A simulation has been conducted in this study to show how this structure can control the micromirror angle. The simulation shows that the alignment range is about +/- 3 degrees for a 2mm x 2mm bimorph consisting of polysilicon and gold. In addition to simulation, we will also report the experimental results of the device fabricated.

References

[1] Jianglong Zhang and Y. C. Lee, "THERMAL BASED ANGLE FIXING FOR MICROMIRRORS," TRANSDUCERS '03, 1470-1473, 2003

Keywords: MEMS, bimorph, fix