ABSTRACT

CHINTAPATLA, SHRAVAN. Electrostatic MEMs Fabry-Perot Modulators in the Visible Spectrum and Electrothermal Wrinkling of Bilayer Thin Films. (Under the direction of John F. Muth and Leda M. Lunardi).

Silicon micromachining was used to form silicon nitride microbridge mirrors and to make micromachined Fabry Perot cavities. The position of the mirror can be controlled either electrostatically, or electrothermally allowing resonance of the Fabry Perot cavity to be controlled resulting in the transmitted or reflected light to be modulated.

Modulation rates of up to 150 KHz were observed when operated electrostatically. Chips with arrays of microbridges were fabricated and the uniformity in wavelength response across the chip was investigated. It was found that using indium bump bonding was superior to using SU-8 as the bonding layer since the uniformity was more controllable.

Electrothermal operation revealed interesting wrinkling phenomena. When electric current was passed through the thin aluminum layer on the silicon nitride membrane joule heating caused the aluminum layer to thermally expand resulting in a compressive stress. The compressive stress and thin sheet geometry of the bridge then resulted in the formation of periodic series wrinkles. The number spacing between the wrinkles was found to be controllable with voltage. The formation of periodic wrinkles was found to be dependent on width to length ratio and the grain size of the evaporated aluminum film. The formation of wrinkles also allowed the finesse of the Fabry Perot cavity to be controlled rather than the distance between the mirror also allowing the light to be modulated or switched on/off in intensity.

Electrostatic MEMs Fabry-Perot Modulators in the Visible Spectrum and Electrothermal Wrinkling of Bilayer Thin Films

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