

Complex MEMS Device: Microshutter Array System for Space Applications

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ABSTRACT

A complex MEMS device, microshutter array system, is being developed at NASA Goddard Space Flight Center for use as an aperture array for a Near-Infrared Spectrometer (NirSpec). The instrument will be carried on the James Webb Space Telescope (JWST), the next generation of space telescope after Hubble Space Telescope retires. The microshutter arrays are designed for the selective transmission of light with high efficiency and high contrast. Arrays are close-packed silicon nitride membranes with a pixel size close to 100x200 μm . Individual shutters are patterned with a torsion flexure permitting shutters to open 90 degrees with a minimized mechanical stress concentration. Light shields are made on to each shutter for light leak prevention so to enhance optical contrast. Shutters are actuated magnetically, latched and addressed electrostatically. The shutter arrays are fabricated using MEMS bulk-micromachining technologies and packaged using single-sided indium flip-chip bonding technology. The MSA flight concept consists of a mosaic of 2 x 2 format of four fully addressable 365 x 171 arrays placed in the JWST optical path at the focal plane.

KEYWORDS: microshutter, MEMS, DRIE, indium bump bonding, packaging, micro-optics, near infrared, space telescope