An 8192-Channel Grating Light Valve for Ultra-Violet Direct Imaging

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August 20, 2010

Direct-write (mask-less) lithography holds the potential of revolutionizing electronic fabrication since it allows direct transmission of graphical data to the media, eliminating the time and cost associated with mask fabrication and maintenance. In this work, we describe an 8192-channel direct-write linear spatial light modulator capable of 10-bit amplitude modulation and 8-bit pulse width modulation. The device functions over UV wavelengths from 350-400nm at pixel rates >2 Gpixels/s.

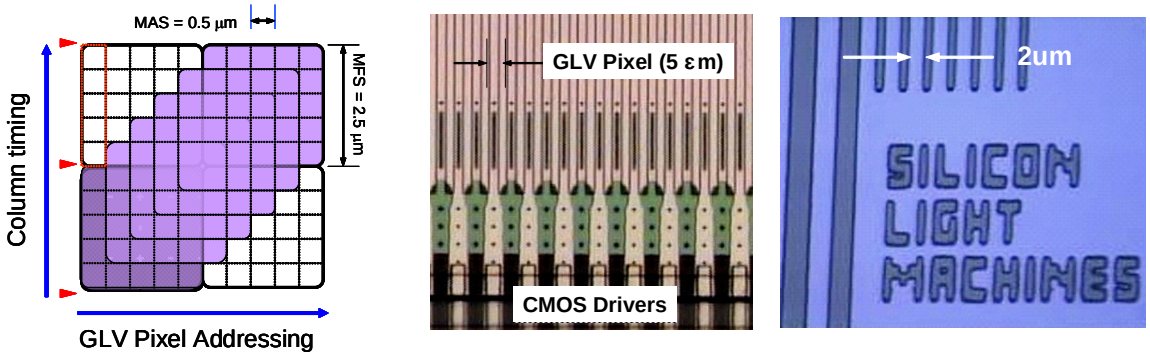

Figure 1. (a) Minimum addressable space & feature-size of GLV-based UVDI system. (b) Photo of 8192 channel ñViperò device with 5um sub-pixel. (c) 2um lines/spaces in photo-resist written with 355nm light.

The UVDI modulator was designed for a minimum feature size of 2.5 um and a minimum addressable size of 0.5 um (Figure 1a). In conjunction with a 10X demagnification, this corresponds to a physical sub-pixel width of 5um. Five contiguous sub-pixels compose a 25um GLV pixel. Each GLV pixel comprises an aluminized silicon-nitride ribbon separated by an aluminized gap (Figure 1b). The vertical separation between the ribbon and gap is electrostatically tuned in order to continuously vary the intensity of reflected light. Due to the high channel count, CMOS channel drivers were monolithically integrated alongside the GLV MEMS. Using a three-metal layer 0.35um silicon process, analog sample-and-hold channels and an 8-bit digital delay bus were incorporated on the chip. The chip is socket-mounted in a ceramic package on a custom printed circuit board. High-speed on-board DACs supply amplitude data to the chip. Digital delay data and overall timing control is carried out through dual onboard FPGAôs running at 66-80MHz.

The lithography tools developed by SCREEN incorporates eight GLV modulators operating in parallel. High-quality patterns have been written in photo-resist using 355nm quasi-CW laser illumination (Figure 1c).