

# Aperture Multiplexing for a Multilayered Waveguide Holographic Read-Only Memory

Holographic memories are regarded as candidates to succeed Digital Versatile Discs (DVDs). However, conventional volume holographic memories require costly imaging lenses and lasers with highly accurate wavelength. To address this problem, we have developed the MWH-ROM, which does not use these components, under a project that the Optoelectronic Industry and Technology Development Association contracted with the New Energy and Industrial Technology Development Organization.

An MWH-ROM medium consists of stacked slab waveguides made of UV curable resin as shown in Fig. 1. Each waveguide bears a relief hologram that diffracts the guided wave to generate a wave, which constructs an image outside the medium. This image is captured by the image detector and is decoded to read the stored data. We have already succeeded in obtaining readout from a 100-

layer medium. The achieved data density, however, has remained at 1.4 Gbit/inch<sup>2</sup>, which is much smaller than the potential density exceeding 100 Gbit/inch<sup>2</sup>.

Hence we proposed a multiplexing method that we call aperture multiplexing. We designed each waveguide hologram so that it generates a wave that consists of multiple wave components, each of which constructs a distinct image. Each image is observed by placing an optical mask between the medium and the image detector and letting one of the wave components transmit it. Figure 2 shows four examples of nine images observed from one hologram by using a liquid crystal device as the optical mask. For these images we were able to obtain a data density of 13 Gbit/inch<sup>2</sup>, which is nine times larger than that obtained without using this technique.

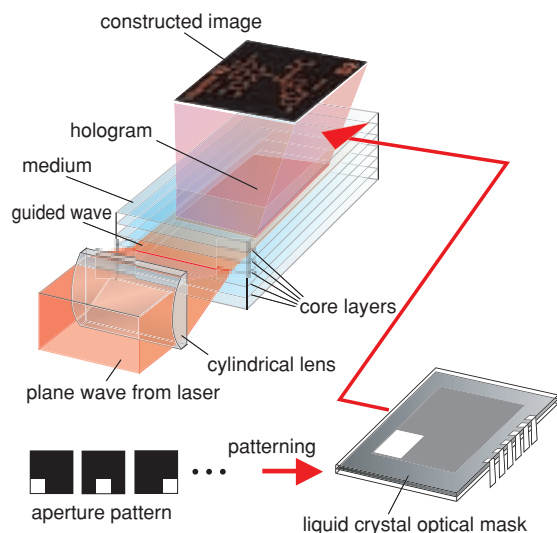


Fig. 1 MWH-ROM and aperture multiplexing principles

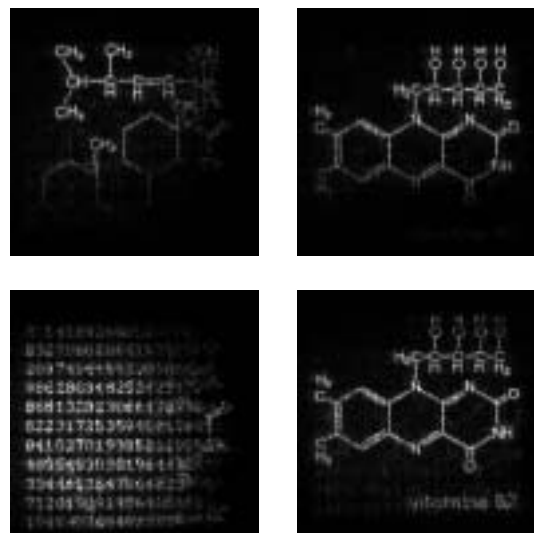


Fig. 2 Example images distinctly observed from one waveguide hologram by using a liquid crystal optical mask

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