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Copying computer-generated holographic interconnectors

A. Fimia, R. Fuentes and I. Pascual

Laboratorio de Optica, Departamento Interuniversitario de Optica, Universidad de Alicante, Apdo. 99, Alicante E-03080, SPAIN.

J.J. Egozcue and M.T. Navarro.

Departamento de Matematicas Aplicadas III, Universidad Politecnica de Cataluña, Barcelona, SPAIN.

ABSTRACT.

The influences and potential uses of holographic recording materials in the obtention of interconnected holographic systems is discussed. Our analysis is done by copying computer generated interconnectors, which produce 64 diffracted beams on axis. The materials that have been studied in the copy process are dichromated gelatin, bleached photographic emulsion and photorresist. Improvement was measure by comparing the data corresponding to the original with those from the copy. Partially coherent light has been used in the copy process.

2.- INTRODUCCTION.

Computer generated holograms have been demostrated to be an excellent way to design holographic interconnectors because it is possible to control the profiles of the interferential patterns, thereby optimizing the signal to noise ratio (SNR) and the diffraction efficiency (DE).On the other hand, previous papers have proposed the possibility of mass producing holographic optical elements through a copying process with partially coherent light[1]. In this paper we presnt our experimental results in copying holographic interconnectors . The original system is an interconnector of 64 beams, generated by computer and obtained through photorreduction in photographic emulsion 8E 56 HD (1 cm^2 size).

The copying process consists of storing the interference patterns that are generated in the master hologram in a recording material with sufficient spatial resolution. We place the master interconnector in direct contact with the recording material that we want to use to make the copy, with the photosensitive layers of the master and the copy placed together. In this step of the process, partially coherent light was used in order to prevent certain noise sources during the copying process [2].

3.- RECORDING MATERIALS.

Experiments were carried out with DCG from Kodak 649 F emulsion, positive photorresist from Shipley AZ-1350 J and B, and photographic emulsion 8 E 75 HD.

A collimated beam from a high-pressure mercury lamp (λ = 405 nm), which was incident to the master and copy, was used to expose the recording materials. The exposed plates were developed. Details of the processing schedule are given in reference 1. The bleached photographic emulsion was developed with a Ascorbic Acid and Sodium Carbonate compound and bleached in R-9.

4.- MEASUREMENTS.

The diffraction efficiency was measured in each of the 64 diffracted beams and the SNR was calculated measuring light that was diffused among the different diffracted beams according to the following equation:

$$SNR = \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{DE_i}{DE_{ij}}$$

where (DE)i is the light diffracted by the i-beam and (DE)ij is the light diffracted between the i and j beams. We also evaluated the differences between the diffraction efficiency corresponding to the different interconnector beams using the expression:

$$D(DE) = [DE(max) - DE(min)]/[DE(max) + DE(min)]$$

A Q factor defined as the value of the maximum diffraction efficiency, multiplied by the SNR and divided by the dispersion that exists between the maximum and minimum values for the diffraction efficiency, gives us the overall optimal characteristics of the interconnector. Table I shows a summary of our results.

TABLE I

PROCESS	$DE_{(max)}$(%)	$DE_{(min)}$(%)	SNR	D(DE)%	Q
Original	1,6	0,5	22,3	0,55	66
Solvent Bleaching	7,3	2,1	1,4	0,55	19
Photorresist	4,2	1,2	3,7	0,55	29
DCG	11,6	1,6	5,4	0,75	63

4.- CONCLUSIONS.

As we can see in Table I, the copy interconnectors have a better diffraction efficiency than the original, but only DCG gives us an experimental Q factor better than the master. More efforts should be made to improve and optimize processing and recording materials if we wish to obtain interconnection systems that have high diffraction efficiencies and SNR. Our experience with recording materials leads us to believe that hybrid processes such as SHSG[3] can provide the solution for this kind of problem.

5.- REFERENCES.

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