

7.16 Recording of reflection holograms in photopolymer layers on plastic substrates

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Background:

Holography is an expanding field with many applications in a wide range of areas. Aside from the commercial applications to security (e.g. passports, driving licences) and in packaging of products, further research has allowed for expansion into areas such as non-destructive testing, and holographic optical elements. Further advances in the field of data storage are a positive indication of the role holograms can play in the future.

The Centre for Industrial and Engineering Optics (IEO) in Dublin Institute of Technology has been developing photopolymer materials for the recording of holograms over a number of years [1-3]. This photopolymer has obvious advantages over other photographic emulsions such as silver halide as it requires no post-processing; the holograms are viewable immediately and are bright in diffuse light. This makes them very suitable for production for industrial applications. Some examples of reflection and transmission holograms recorded in IEO photopolymer are shown in Figure 1.

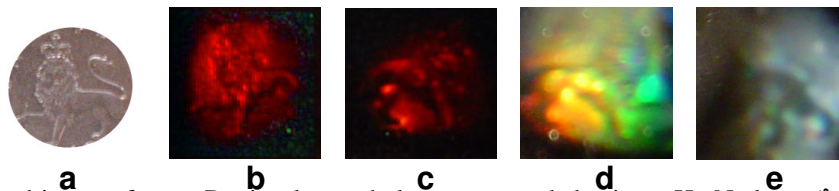


Fig.1. Reconstructed images from a Denisyuk type hologram, recorded using a He-Ne laser ($\lambda = 633 \text{ nm}$): (a) the object; (b) reflection hologram 1 (reference beam, object beam); (c) reflection hologram 2 (reflected reference beam and reflected object beam); (d) transmission hologram 1 (reference beam and reflected object beam); (e) transmission hologram 2 (reflected reference beam and object beam).

At present the holograms recorded in the IEO photopolymers are in photopolymer layers deposited on glass plates. Most of the possible industrial applications of holograms require that the holograms are recorded on plastic substrates. That is why developing of a method for recording of holograms in photopolymer layers on plastic substrates is an important task.

Objectives:

- To gain an understanding of the underlying principles involved in the formation of holograms
- To acquire experimental skills in the recording of reflection and transmission holograms
- To develop a method of recording of reflection holograms in photopolymer layers on plastic substrates
- To record bright reflection holograms on plastic substrates

Methodology:

- 1) prepare photopolymer layers of good optical quality
- 2) record holograms in photopolymers layers on plastic substrates
- 3) investigate the Diffraction Efficiency and Refractive Index Modulation of recorded holograms

Learning Outcomes:

- 1) an understanding of the basic physical principles of holography
- 2) skill in handling photopolymer materials and in the preparation of optical quality layers
- 3) skill in recording transmission and reflection holograms
- 4) ability to write and to make presentation of the research work done
- 5) ability to write a scientific paper for publication

References

- [1] S. Calixto, *Appl. Opt.*, **36**, 3904-3910, 1987.
- [2] S. Martin, C. A. Feely, and V. Toal, *Appl. Opt.*, **36**, 5757-5768, 1997.
- [3] I. Naydenova, R. Jallapuram, V. Toal, S. Martin, **92**, 031109, *Appl. Phys. Lett.*, 2008