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# Blur suppression of a holographic image with use of surface plasmons

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## 1. Introduction

Holography is well-known technique of 3-dimensional imaging. A medium recorded the image is called hologram. To reconstruct objects, the holograms are illuminated with light waves. When fluorescent tubes or light emitting diode (LED) arrays illuminate holograms, reconstructed images are blurred, since a position of reconstructed image depend on illumination angle and angular-spreading light waves emitting from these plane light-sources reconstruct a series of the holographic images. Here we propose a blur suppression method of the holographic images by limiting incident-angle spreading of light waves by using surface plasmon polaritons (SPP) [1].

## 2. Principle of blur suppression of holographic images

Figure 1 (a) is cross-sectional view of the SPP hologram. Illumination satisfying excitation condition (incident angle $\theta_i$) excites SPPs on the silver surface, and reconstructs a holographic image. Even if the hologram is illuminated with angular spreading light, only the illumination satisfying excitation condition excites SPPs. Thus the blur may be suppressed. Figure 1 (b) is non-plasmonic hologram (no silver film). When angular spreading light from plane sources illuminate the hologram, illuminations with different incident angles simultaneously reconstruct hologram. Consequently, a series of holographic images are reconstructed to slightly-different positions, and these images make blur.

## 3. Blur suppression in experiment

We conducted experiments to confirm the blur suppression of images. An object recorded in hologram is a rose-shape relief. The details of the process, such as recording, developing, and coating the metal film and dielectric film, are the same as those in ref. [2]. Illumination of hologram is a He–Ne laser ($\lambda$ = 632.8 nm) with a beam expander and an optical diffuser.

Figure 2 (a) and (b) shows experimental results of the SPP and non-plasmonic hologram, respectively. An image blurring of SPP hologram is clearly suppressed, compared with non-plasmonic one.

## 4. Conclusion

In conclusion, we demonstrated SPPs suppress the image blurring caused by angular-spreading light waves from area light-sources. This scheme may realize hologram reconstruction with fluorescent tubes or LED arrays, which is embedded in mobile devices.

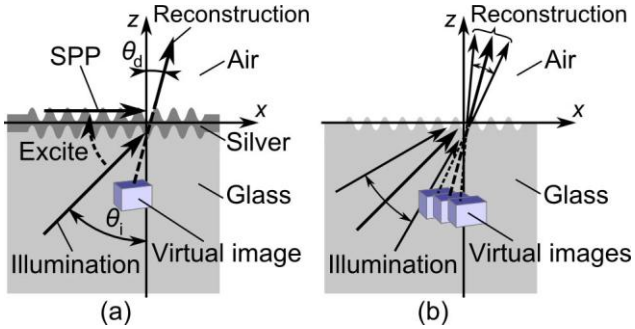


Fig. 1 (a) Reconstruction scheme of SPPs hologram (cross section). Hologram is recorded as corrugations of the silver film. Light illuminating hologram with incident angle $\theta_i$ excites SPPs, which reconstruct hologram. (b) nonplasmonic hologram. Illumination with a variety of incident angles reconstructs a series of virtual images, which causes blurry.

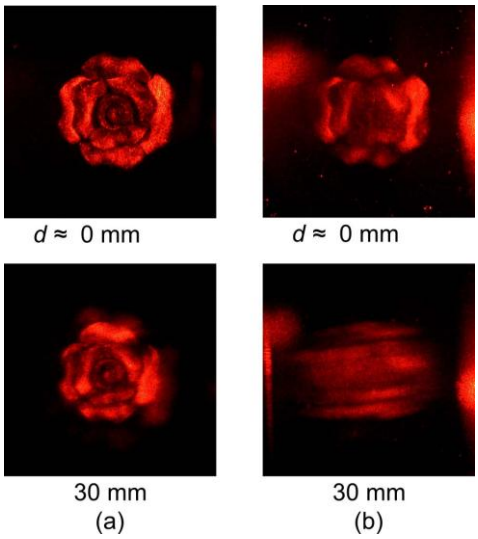


Fig. 2 Reconstructed images. $d$ is a distance between hologram and reconstructed image. The image blur theoretically increases with $d$. Size of images is about 10 × 10 mm. (a) SPP hologram. (b) non-plasmonic hologram. At $d \approx$ 20 mm, it becomes hard to recognize details.

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## References

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