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Three dimensional light manipulation for full-color nano-projector

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1. Introduction

Using plasmonic nanostructures to manipulate the scattered light from the SPP waves will be experimental demonstrated. The surface plasmon waves can be scattered and modified by various plasmonic structures composed of gold nanobumps. The height and intensity profile of the focusing patterns are precisely controlled in three-dimensional space by the curved arrangement of nanobumps. The modulation of the projecting height of the focusing pattern is reached as high as 10 micron-meters. The intensity profile of focusing pattern can be approached to a diffraction-limited spot. The projecting image constructed by focusing spot from designing nanobumps arrangement is achieved in three-dimensional space.

2. General Instructions

Using nanostructures to manipulate surface plasmon polariton (SPP) plane waves is an important issue. The interactions of plasmonic nanostructure on SPP wave involve not only the in-plane behavior, but also out-of-plane scattering which is captured as the far-field radiation. Recently, three-dimensional focusing and diverging of SPP waves by a quarter circular structure composed of Au nanobumps were studied. The Au nanobumps confer additional three-dimensional propagating wave vectors on SPP wave for departing from surface. It is possible to manipulate the three-dimensional plasmonic scattering by arranging the Au nanobumps. In this work, we manipulate the scattering of SPP waves by various plasmonic structures composed of arranged nanobumps on a gold thin film. Upon controlling the geometry of the plasmonic structures, the height, position, and pattern of scattered light can be modified as desired. It provides a simple and efficient way to project a specific light pattern into free space, and demonstrate the capability of three-dimensional light manipulation. By precisely designing a particular curved structure with appropriate radius of curvature and adjacent interspacing of nanobumps, we can construct a clear single focusing spot at a specific altitude. The irregular light patterns of the scattering of designed structures are observed at any observation plane, except for the scattering-light-focal plane where observing the focusing spot of curved structure. When the focal plane is shifted to this scattering-light-focal plane, the "NTU" light patterns are clearly observed. Under the different color laser which are green, blue and red illuminating, the "NTU" pattern are observed with different color respectively. Figure 1 shows the "NTU" pattern is illuminated by green laser. These results confirm the controllability of the focused spot in three-dimensional space by settling curved structures.

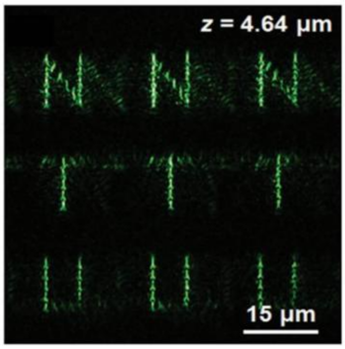

Figure.1 imagine of the NTU pattern whch is illuminated by green laser.

3. Conclusions

The out-of-plane plasmonic light manipulation by converting the SPP wave into radiaotpn using various fs-laser fabricated nanobumps on Au thin film. Not only the altitude of the focused light pattern is modulated by adjusting the RCs of curved structures ,but also the interspacing of adjacent nanobumps in curved structures determine the intensity distribution of the focused pattern. The curvature condition the optical path length and the interspacing of adjacent nanobumps govents the kx propagating wave vector. The three dimensional light projection is achieved as long as the arrangement of nanobumps are precisely designed. The full color nano projector

References

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