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Imaging of Localized Surface Plasmon Polaritons by Apertureless Scanning Near-field Optical Microscopy

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1.Intoroduction

In the field of nanophotonics, localized surface plasmon polaritons (LSPPs) are important physical phenomena. One of the most important an application will be nano-size circularly polarized light generated by nano-structures such as a cross aperture antenna [1]. An imaging technique with high spatial resolution is essential for the analysis and the evaluation of LSPPs. In this presentation, we report on a measurement of LSPPs in Au pattern structures by an apertureless scanning near-field optical microscopy (a-SNOM) with a high spatial resolution of about 10 nm.

2.Experiment method

We used a He-Ne laser (HN-410P, NEOARK, Japan) with a wavelength of 633nm as a light source and silicon cantilevers (PRC-DF40P, Olympus, Japan) with curvature radius of 20 nm as optical probes. The s-polarized light illuminated with an angle of 45° inclined from the substrate normal to Au patterned structures with cross-shaped apertures prepared by focused ion beam (FIB). The scattered light from the near-field region was detected by a photomultiplier tube and measured using a lock-in amplifier (7280 DSP LOCK-IN AMPLIFIER, Signal Recovery).

3.Results and discussion

AFM and a SNOM images of a Au patterned structure with a cross-shaped aperture are shown in Fig.1. The arrow shown in Fig.1 represents a direction of electric field of an incident light with s-polarization. In the SNOM image, we obtain the strong intensity at the edges of the pattern. Strong electric fields at the edges were also observed in a simulation as show in Fig.2, which is due to LSPPs induced in the Au pattern. We consider that the strong intensity observed at the edges of the pattern in the SNOM image is due to LSPPs, since the simulated electric field distribution is similar to the SNOM image.

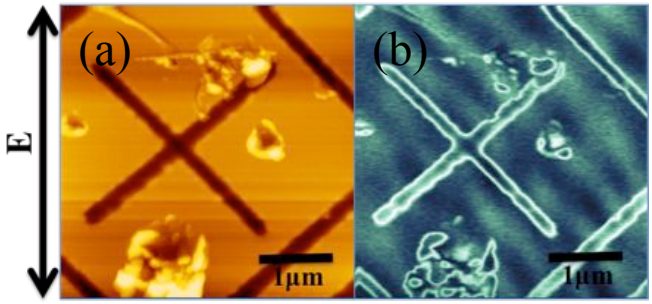

Fig.1 (a)AFM and (b)SNOM images of an Au aperture measured with s-polarization illumination.

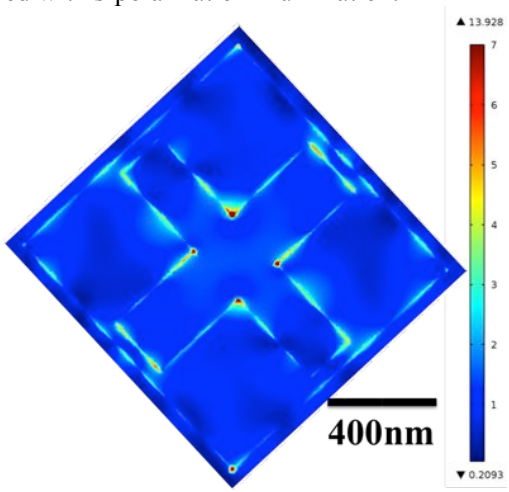

Fig.2 The electric field distribution on an Au aperture calculated for s-polarization illumination.

Acknowledgements

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References

[1] K. Nakagawa et al., JAP, **109** 07B735 (2011)

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