

Real-time observation of birefringence by laser scanning surface plasmon microscope

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Recently we developed a laser scanning surface plasmon microscope and demonstrated the developed system can realize highly spatial resolution without lack of high sensitivity to thickness and refractive-index distributions[1]. In this paper, we applied this technique to observe the orientation of the anisotropic materials such as liquid crystal, poled dye molecules, and so on. Figure 1 (a) shows the experimental setup of the developed system. Silver thin film was evaporated on the high index cover slip ($n=1.78$ and $170\mu\text{m}$ in thickness). The sample was attached on this silver thin film. A He-Ne laser ($\lambda=632.8\text{nm}$) was used as a light source. The laser beam was collimated and focused on the glass-silver interface by using high NA objective lens ($\text{NA}=1.65$) and this focused laser excites surface plasmon locally on the silver-sample interface. Reflected light from silver film was collected by the same objective lens. The angular spectrum image of the reflected light was created on the pupil plane of the objective lens, and it was observed by CCD camera. When the surface plasmon was excited, the reflection light whose incident angle is corresponding to the excitation angle of SP is decreased due to the absorption of SP and the dark ring was created. From the radius of the ring we can measure the refractive index of the sample with high-sensitivity.

When birefringent material was located on the silver thin film, this dark ring changes to the ellipsoid according to its anisotropy as shown in Figure 1 (b). Hence, by observing the size and direction of this elliptic dark ring, the system can measure the birefringence and direction of the anisotropy of the materials. This method does not need any movement of the optics

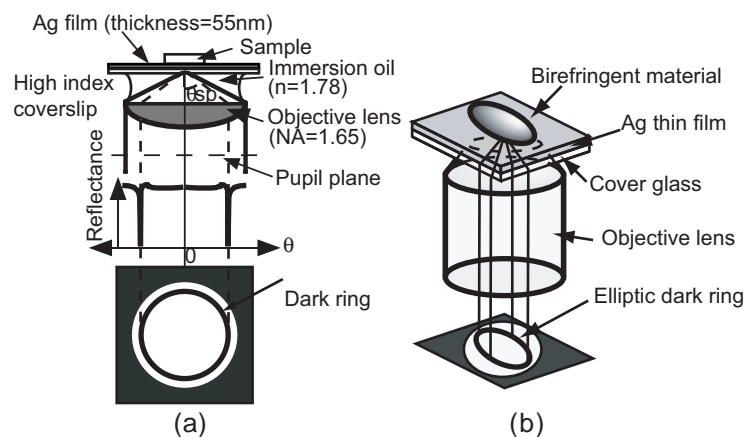


Fig. 1. Optical setup of laser scanning surface plasmon microscope

such as analyzer in conventional polarizing microscope, it can obtain the change of the birefringence in real time. The limitation of the measuring range against the sample's index are also discussed.

[1] T. Tanaka and S. Yamamoto, "Laser-scanning surface plasmon polariton resonance microscopy with multiple photodetectors," *Appl. Opt.* **42**, 4002-4007 (2003).