Supporting Information

Distortion Correction for a Brewster Angle Microscope Using an Optical Grating

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The new Brewster angle microscope setup

The BAM is constructed based on a ruled optical reflection grating (Richardson Grating, 1500 mm⁻¹) as shown in Figure 1 of the manuscript. An attenuator is placed after a 532nm continuous-wave laser (Compass 115M-5, 5mW, Coherent Co.), tuning the beam intensity with a half-waveplate (Thorlabs) and converting the beam to p-polarization with a Glan-Thompson polarizer (100000:1, Thorlabs). The beam is aligned by two silver mirrors (Thorlabs) and set at the Brewster angle of the sample surface. The sample image is projected onto the grating surface through a 1:1 relay lens (45mm focal length f/4, Edmund optics). The beam hits grating at the 1st order diffraction angle and then travels perpendicular to the objective focal plane. It is magnified by an objective (Mitutoyo, M Plan Apo SL 20x) with its long working distance of 30.5mm. The final image is then captured by a digital camera (Nikon D5000). The resolving power of the BAM is tested by a USAF 1951 optical target (Newport Optics).


A Langmuir monolayer of Dipalmitoylphosphatidylcholine (DPPC, Sigma-Aldrich, ≥99%) on a water surface and a Langmuir-Blodgett monolayer of stearic acid (SA, Sigma, ≥98.5%) on a z-cut quartz (Knight Optical, UK) surface are tested by BAM. The DPPC monolayer at the air/water interface is prepared at 20.8 °C, by injection of 10µL of 2.5mg/mL DPPC chloroform solution on the surface of pure water in a Langmuir Trough (KSV NIMA) with a compression rate of 3.6Å²/(min-molecule). An SA Langmuir-Blodgett monolayer is deposited onto the surface of the quartz window at 4mN/m with withdrawing speed 3mm/min.

The incident angle is calculated by the Brewster angle condition of different substrates. At the listed experimental conditions, the incidence angles for water and quartz are chosen to be 53.1° and 55.6° based on the refractive index of 1.33 and 1.46, respectively.

Resolving power by Rayleigh criterion
The resolving power $R$ of the optical components can be estimated by the Rayleigh criterion:\(^1\):

$$R = \frac{0.61\lambda}{N.A.}$$

where $\lambda$ is 532nm, the N.A. of the objective is 0.28 and the N.A. of the relay lens is 0.124. Since the smallest N.A. limits the resolution of the entire imaging system, the BAM resolution is thereby determined by the relay lens, yielding a final estimated resolution of 2.6µm.

References: