

Confocal Microscopy in Combination with a Solid Immersion Lens for Enhanced Resolution

Confocal microscopy provides several advantages over conventional wide field optical microscopy including elimination of image degrading out-of-focus information and the ability to acquire serial optical images in successive thin sections from thick specimen. Confocal microscopy relies on two strategies: a) Illumination of a single point of the specimen at a time with a focused beam so that the illumination intensity drops rapidly above and below the plane of focus and b) using a blocking pinhole aperture in a conjugate focal plane to the specimen eliminating degrading out-of-focus information. Solid immersion microscopy, where light is focused inside a high refractive-index lens close to a sample, offers a method for achieving resolution well below the diffraction limit in air. Combining these techniques, major improvement of resolution and light throughput are achieved in addition to offering a very simple experimental setup compared to other high resolution optical techniques, e.g. scanning near-field optical microscopy (SNOM).

In the confocal setup, the solid immersion lens is applied directly on the surface of the investigated sample, which was a SiO₂ on Si chess board with two microns in period. A schematic drawing of the experimental setup is shown in Figure 1. The confocal microscope attoCFM II was used first to acquire an image of a sample without the solid immersion lens, and second, to acquire an image with the solid immersion lens. The purpose is to determine the increase in the resolution. The wavelength used was 635 nm. The diffraction limited confocal objective had a numerical aperture of 0.55, thus leading to a lateral resolution of 700 nm. Figure 2 shows the image and a line cut recorded without the solid immersion lens. The micrometer sized structures are clearly resolved. Figure 3 shows the image acquired using the solid immersion lens. The measured resolution was about 160 nm. This ultra-high resolution is also attributed to the confocal setup using a pinhole that leads to an additional enhancement of the resolution.

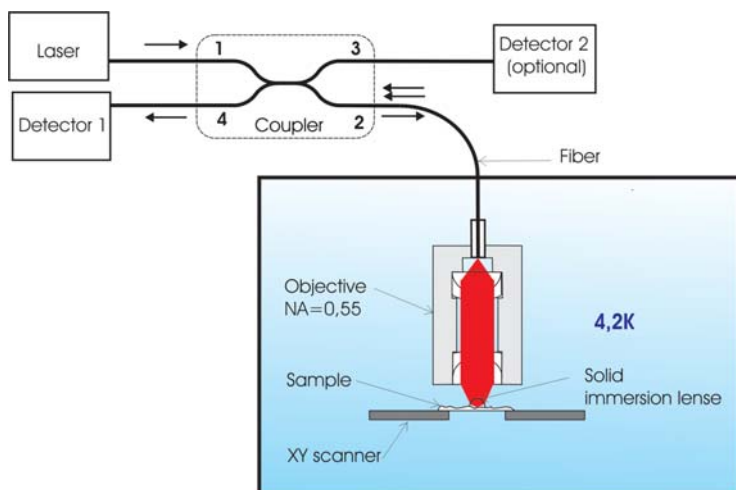


Figure 1: Schematic drawing of the attoCFM II setup including the solid immersion lens.

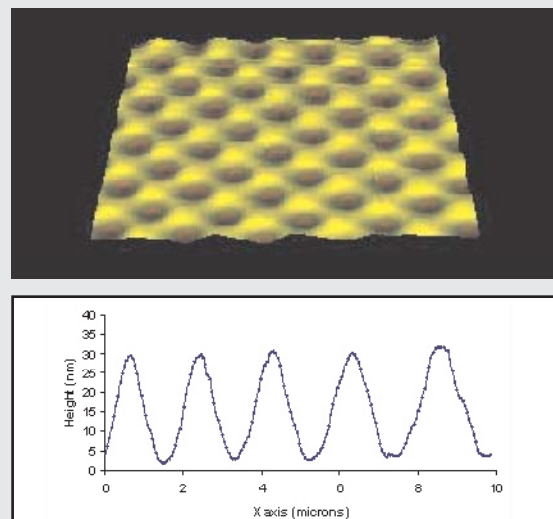


Figure 2: 3D-view and line cut of the image acquired with the attoCFM II confocal microscope. The sample is a chess board with 2 microns in period.

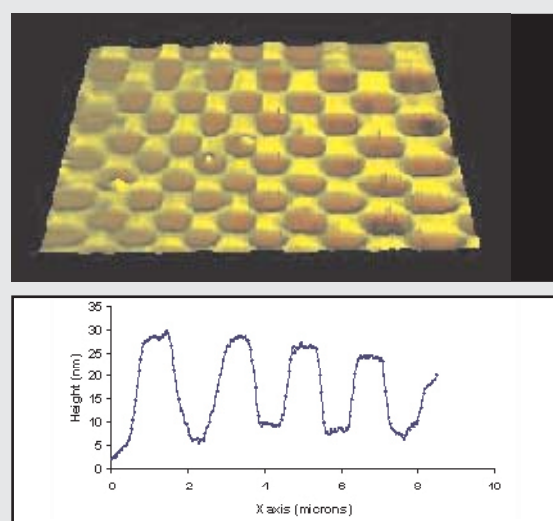


Figure 3: 3D-view and line cut of the image acquired with the attoCFM II in combination with the solid immersion lens.

| RELATED PRODUCTS | |
|------------------|---|
| attoCFM II | highly stable confocal microscope |
| ANPxyz100 | high precision, piezo electric, inertial positioner for big loads |
| ANSxy100 | high precision piezoelectric scanner |
| ANC150/3 | electronic controller |
| ANC200 | electronic scan controller |
| attoScan | data acquisition software |
| atView | data viewing and editing software |