

SCANNING PROBE MICROSCOPY FOR BIOLOGICAL APPLICATIONSD.Haft¹, O.Sqalli¹, T.Lindenberg¹, C.Bödefeld¹, K.Höfling¹, M.Vogel², C.Schulhauser², A.Högele² & K.Karrai²¹*attocube systems AG, Viktualienmarkt 3, 80331 München, Germany.*²*Ludwig-Maximilians-Universität, Sektion Physik, Lehrstuhl für experimentelle Halbleiterphysik, Geschwister-Scholl-Platz 1, 80539 München, Germany.*

INTRODUCTION: Confocal microscopy and scanning probe microscopy have drawn considerable research interest in recent years since they allow the measurement of both the topography and the optical contrast of a sample with sub-wavelength resolution.

SCANNING PROBE MICROSCOPES: The instruments work by scanning a sub-wavelength sized probe in the near-field of a sample surface. The near-field probe acts simultaneously as a topographic sensor, which allows controlling the tip-sample distance, and as a nanometric optical aperture that records an optical signal. Scanning near-field optical microscopy requires a performant sensor to measure the tip-to-sample distance. In this letter, we report on a novel fiber based AFM¹ and a novel shear-force detection scheme² for scanning near-field optical microscopy applications. They are based on an all fiber lowcoherence interferometer. This setup makes it possible to measure a tip oscillation amplitude of less than 50 pm both in air and aqueous environment with a precision of 160 fm/Hz^{1/2}, thus demonstrating the ability to perform topographic measurements both in air and in liquids with a tipsample distance resolution better than 1 nm. Stable feedback in air and fluids is obtained with tipsample interaction forces below 1 pN.

CONFOCAL MICROSCOPES: Confocal microscopes work by scanning a tiny light spot on a sample and by measuring the scattered light in the illuminated area. Confocal imaging systems achieve out-of-focus rejection by two strategies: a) by illuminating a single point of the specimen at any one time with a focused beam, so that the illumination intensity drops off rapidly above and below the focus plane and b) by the use of blocking with a pinhole aperture in a conjugate focal plane to the specimen so that light emitted away from the point in the specimen being illuminated is blocked from reaching the detector. By scanning many thin sections through a sample, one can build up a very clean three-dimensional image of the sample.

Confocal imaging can offer another advantage in favorable situations (small pinhole size, bright specimen): the resolution obtained can be better in comparison with the microscope operated conventionally (see fig. 1). Here we present a very compact and easy to use confocal microscope that is compatible with low temperatures, high magnetic fields and high vacuums. The stability of the microscope is higher than three months: indeed three months long spectroscopy measurements have been achieved on a single semiconductor quantum dot of about 10nm size³.

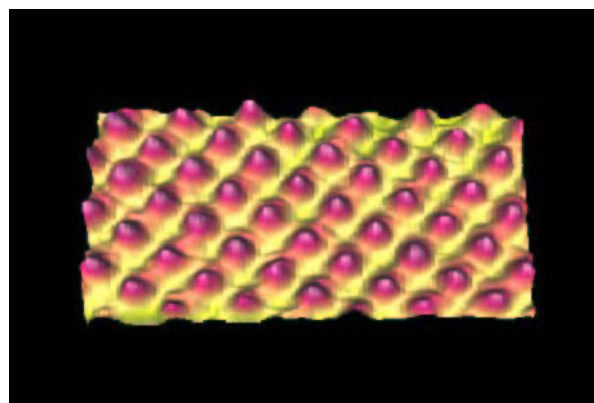


Fig. 1: Confocal image of a chess board with 1 micron of period.

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