ULTRAHIGH-RESOLUTION THREE-DIMENSIONAL IMAGERY BY MULTIPLE LOCAL PROBE MICROSCOPY

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We present a multiple local probe microscope designed to produce ultrahigh-resolution three-dimensional images of internal structures of various samples. This instrument, based on a white-light interference microscope [1,2], uses sub-wavelength (typically of 50 nm radius) spherical gold beads as local probes to explore the three-dimensional structures of the sample.

The experimental set-up consists of a Michelson interferometer with identical microscope objectives in both arms [3,4]. Due to the ultra-short coherence length of the source, only the light back-scattered by the beads located in a thin slice inside the sample generates an interferometric signal. A Xenon flash lamp (10 µs pulse duration) is used to freeze the Brownian motion of the beads. The three-dimensional position of each bead is determined by analyzing two orthogonally polarized interferometric images, recorded by two high-resolution CCD cameras. The concentration of the beads is weak enough to observe them independently and high enough for a powerful parallel exploration. The measurement of the successive bead positions allows us to reconstruct the explored volume borders. Spatial resolution of the order of the beads' diameter is achieved.

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