

# STRUCTURED-ILLUMINATION MICROSCOPY USING EXTRAORDINARY TRANSMISSION THROUGH SUB-WAVELENGTH HOLE-ARRAYS

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## ABSTRACT:

Structured illumination microscopy, like confocal microscopy, is a common way to observe fluorescently stained samples with higher resolution than a wide-field microscope. There is only one scanning confocal spot; with multiple spots faster acquisition is possible. Instead of using a Nipkow disc, however, we use transmission through a metal hole-array. The microscope termed midfield [1] uses a near-field phenomenon, extraordinary transmission (EOT) of light, for excitation and detects fluorescence in far-field.

This EOT [2] is different from the prediction by Bethe [3]. It has spectral selection in that, for some spectral peaks, more light passes through a hole than impinges on it. There is no total diffraction; the angular spread is limited to a few degrees [4]. When the wavelength is shorter than the array period, the transmission forms an interference pattern. The high intensity lobes are positioned above the centers of individual holes or between them. One lobe can be separately imaged from its neighbor because the distance between lobes in the focal plane, depending on the array period, is larger than the point spread function (PSF) of the imaging lens. This is illustrated in Figures 1 and 2.

It has already been shown with 3D surface plasmon assisted nanolithography [5] that this interference exists. We are currently measuring the predicted interference patterns in our microscope; this will be a direct proof of concept. We present the microscope principle, the expected optical properties, and our experimental results.

## REFERENCES

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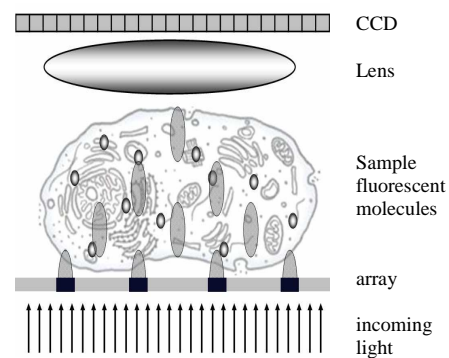


Figure 1: Overview of the midfield microscope

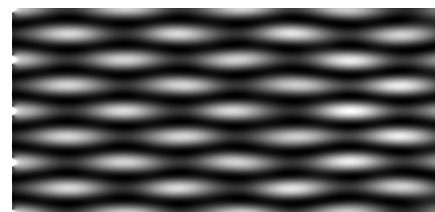


Figure 2: Simulated transmission through array on the left side