

## **On breaking the Abbé diffraction limit in optical nanopatterning and nanoscopy.**

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A technique for creating deterministic structural complexity is essential to achieve high functionality at the nanoscale, whether in electronics, photonics, or molecular biology. Scanning-electron-beam lithography (SEBL) is the most widely used method in research, but it has a number of drawbacks. SEBL tends to be slow, expensive, prone to placement errors, and not compatible with organics and biological material. Ideally one would prefer to employ benign photons in the visible or near IR range for such patterning. However, the so-called far-field diffraction barrier (first realized by Abbé) limits the smallest feature achievable by wavelength,  $\lambda$  to  $\sim \lambda/4$ . In this presentation, I will describe a technique that circumvents this barrier by means of wavelength-selective chemistry. I call the technique *Absorbance Modulation*.

I will also describe the application of absorbance modulation to scanning-optical nanoscopy. Significant excitement has been generated recently by several new techniques for optical live-cell imaging at the nanoscale. All these techniques rely on fluorescence to break the diffraction barrier. I will demonstrate that the far-field diffraction barrier can be overcome without resorting to fluorescence.

Finally, I will describe an alternative to absorbance modulation that exploits unique combinations of spectrally-selective reversible and irreversible photochemical transitions to achieve single-molecule resolution in 3 dimensions.