A Microscope that Sees without Looking

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A new type of microscope overcomes some of the limitations of optical imaging techniques by looking at how samples affect a tiny antenna, rather than looking at the sample itself.

Most optical microscopes create images by collecting photons reflected from a surface. But when samples get very small or have tiny features, the limitations of optics kick in and prevent the imaging of objects smaller than a micron or so across.

Instead of shining a light on a sample, a team of Swiss and German researchers have found that they can take pictures of a small sample by illuminating a tiny, gold antenna placed near a surface. The antenna emits different signals depending on the sample structure. It's much like sweeping a metal detector over the ground to map out the location of a buried pipe – the rising and falling pitch of the metal detector results because the hidden metal changes the way the detector circuit reacts.

Conventional optical microscopy, on the other hand, is more like radar, which would locate a buried pipe by bouncing radio waves off of it. The microscope in the new study consists of an antenna made from a single particle of gold, 100 nanometers in diameter or smaller, mounted on the tip of a glass fiber that is scanned over the sample at a height of 5 to 10 nanometers.

The system provides detail of structures as small as a few hundred nanometers across, but the researchers believe the technique has the potential to be refined to image features a hundred times smaller.

Original work:

Optical Microscopy via Spectral Modifications of a Nanoantenna
T. Kalkbrenner et al.
Physical Review Letters 95, 200801 (2005)
link.aps.org/abstract/PRL/v95/e200801

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