Scanning Near-Field Optical Microscopy (SNOM).

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**Diffraction I**

- **Physical Property.**

- **Airy Disks.**
Diffraction II

- **Resolution.**

- **Abbe Diffraction limit** \( d = \frac{\lambda}{2 n \sin \theta} \).

- **Maximum Resolution** \( d_{\text{Max}} = \frac{\lambda}{2} \).

- **Near-Field** \( r \ll \lambda \).

- **Far-Field** \( r \gg \lambda \).
Apertured Probe

- **Fiber Probe Coated by Thick Metal.**
- **High Temperature.**
- **Advantage.**
- **Disadvantage.**

Aperture-less Probe

- Fiber Probe.
- No Heat.
- Advantage.
- Disadvantage.

G. Kaupp, Atomic force microscopy, scanning near field optical microscopy and nanostructuring.
Apertured Modes of SNOM

http://en.wikipedia.org/wiki/NSOM
The Equipment

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Applications on SNOM

- Physics and Chemistry (Conformation of single molecule, Imaging surfaces, ...).

- Biology (Imaging biological samples like blood, tissues, cancer cells, ...).

- Medicine.
Application I: Conformation of Molecules

- Poly(isobutyl methacrylate)(PiBMA).
- Using Apertured SNOM.
- PiBMA molecule should be flat.
- The solution is water.
- preparing one molecule is impossible.
- Mixing of diluted dying PiBMA with non-dying PiBMA.
- The detector is sensitive to the dying molecules.

Experiment

- **Illumination Mode.**

- **Laser of 415 nm.**

- **Aperture diameter 100 nm.**

- **Normal distance between the probe and the sample is 10 nm.**

- **Shear force feedback is not required.**
The Images

- Sample (a) with concentration 10%.
- Sample (b) with concentration 25%.
- White spots represent the dying PiBMA.
- PiBMA has a circular shape in 2D.
- PiBMA has random walk shape in 3D

Application II: Biological Sample

- The biological material is a mosquito wing.
- The wing surface is not flat.
- The wing was fixed over LiF film.
- Using soft X-rays and EUV.
- Color centers (CCs) will appear on the LiF.
Using SNOM

- Using apertured SNOM of illumination mode.
- A sharp tip was attached at the end of the aperture.
- Aperture diameter 50 nm.
- Ar laser of 458 nm (illuminated light).
- Collected light has wavelengths 550-650 nm.
- Expected resolution is $\lambda/2$. 
SNOM Images

- **Fluorescence image.**

- **Topographical Image.**

• **AA' distance is 50 nm.**

• **Resolution** \( \sim \frac{\lambda}{12} \).

Thank You For Listening

Questions ??