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Optical Antennas

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b Electrons Electrons

Novotny, Physics Today (2011)

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Near-field optics

3. Near-field optics

3.4 Scanning near-field optical microscopy : Methodology

- 3.4.1 Probe concepts and fabrication
- 3.4.2 Surface distance control
- 3.4.3 Optical characterization
- 3.4.4 Artifacts

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Scanning tunneling microscopy (STM)

Principle

J. Heimel / AG Prof. Fuchs © 2000 with POV-Ray 3.0

Silicon surface (111) 7x7

Binnig & Rohrer (1982); AG Fuchs (Uni Münster)

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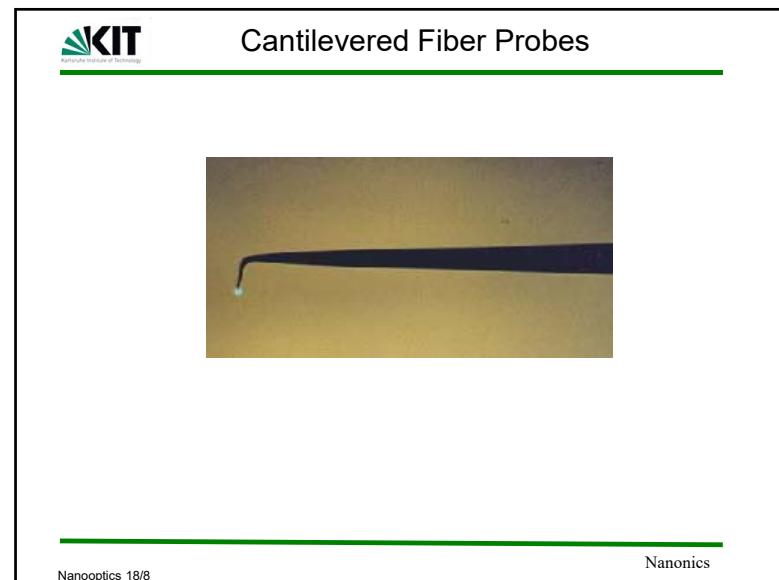
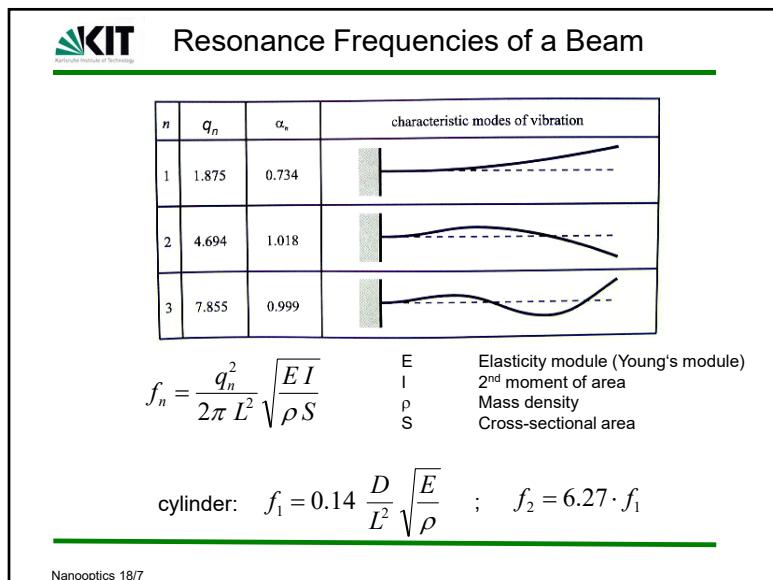
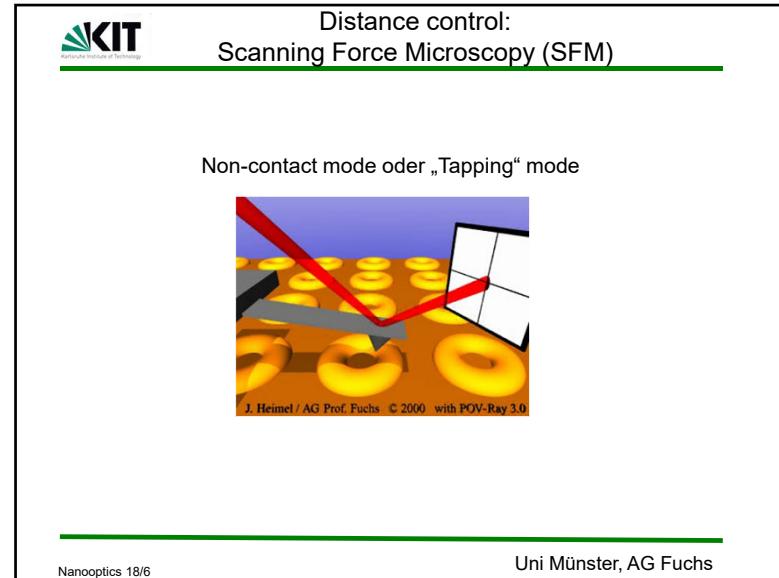
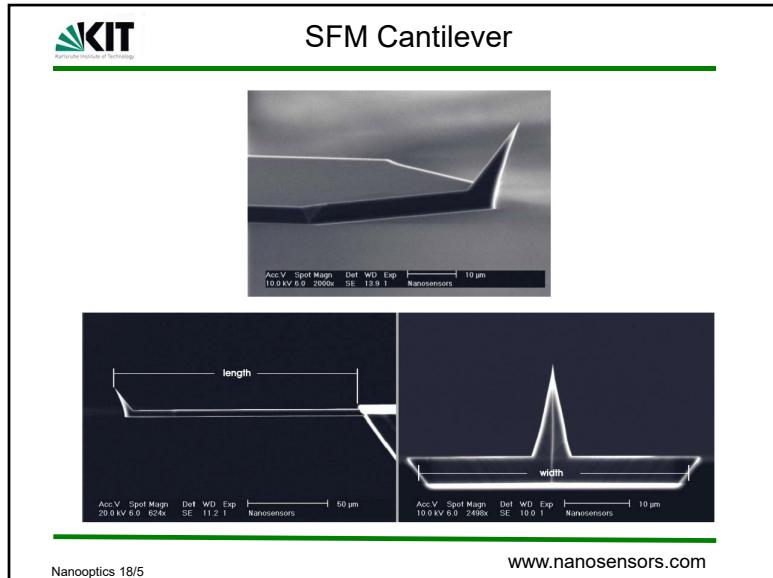
Distance control: Scanning Force Microscopy (SFM)

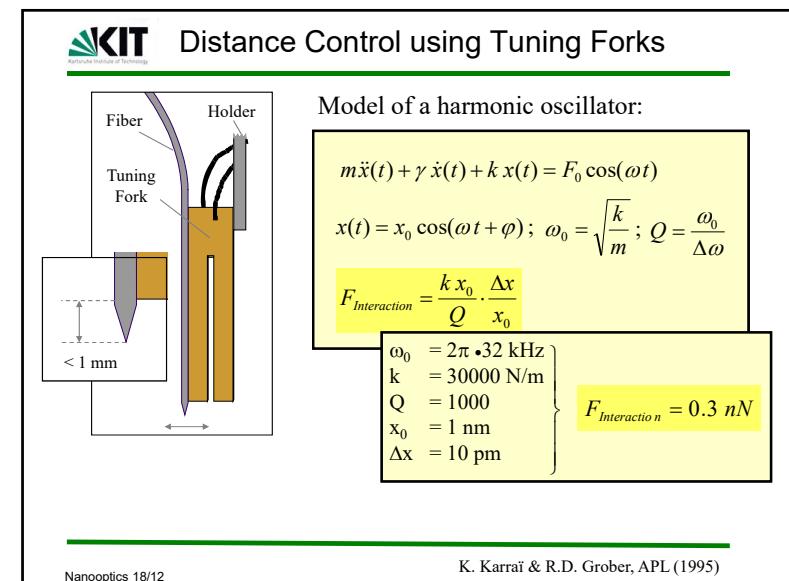
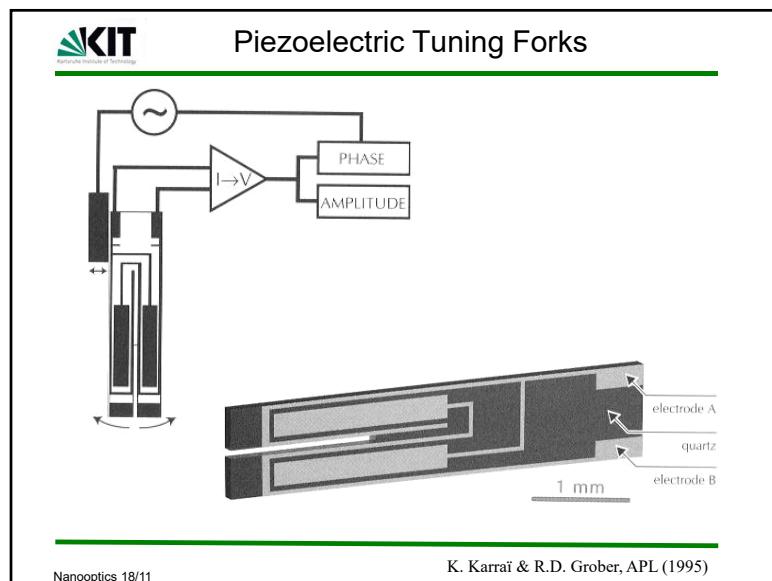
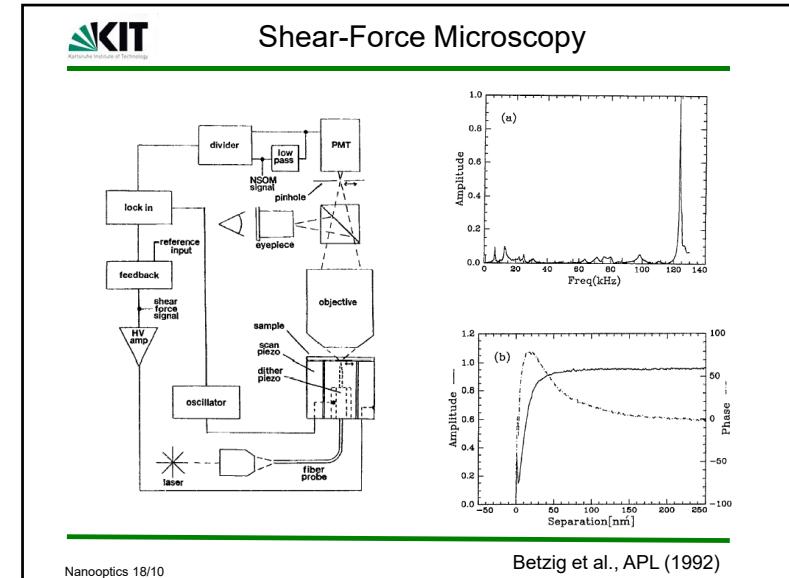
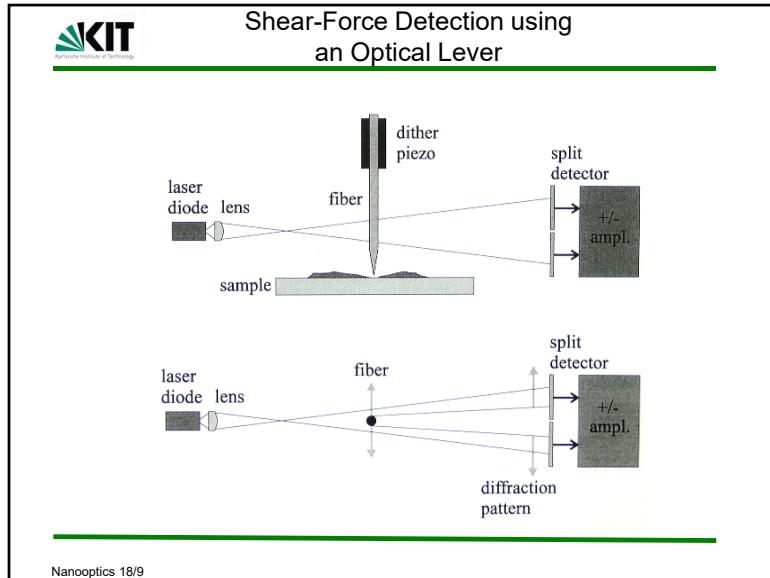
Contact mode

J. Heimel / AG Prof. Fuchs © 2000 with POV-Ray 3.0

Uni Münster, AG Fuchs

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Distance Control using Tuning Forks

Model of a harmonic oscillator:

$$m \ddot{x}(t) + \gamma \dot{x}(t) + k x(t) = F_0 \cos(\omega t)$$

$$x(t) = x_0 \cos(\omega t + \phi); \quad \omega_0 = \sqrt{\frac{k}{m}}; \quad Q = \frac{\omega_0}{\Delta\omega}$$

$$F_{Interaction} = \frac{k x_0 \cdot \Delta x}{Q x_0}$$

$\omega_0 = 2\pi \cdot 32 \text{ kHz}$	$F_{Interaction} = 0.3 \text{ nN}$
$k = 30000 \text{ N/m}$	
$Q = 1000$	
$x_0 = 1 \text{ nm}$	

$\Delta x = 10 \text{ pm}$

Nanooptics 18/13 K. Karraß & R.D. Grober, APL (1995)

