ANALYTICAL CURRENTS

SNOM analysis in the cold

B. Hecht and co-workers at the Swiss Federal Institute of Technology–Zurich have put together a scanning near-field optical microscope that performs not only nanoscale optical imaging and spectroscopy but also tuning-fork shear-force topographic imaging at cryogenic temperatures. They obtained images of a silicon line grating with a tuning-fork shear-force feedback in constant phase at 1.8 K. The group reports the first images from shear-force topography with gap-width control.

The researchers' setup included a scan head placed on top of a sample-scanning confocal optical microscope. They used a quartz tuning fork as the shear-force sensor and attached the gold tip to one arm of the fork that oscillates close to its resonance frequency (~32.7 kHz). The sample was scanned in the x–y direction while the gold tip was moved along the z axis. The tuning fork performed excitation and detection of the resonance, and no alignment was required at 1.8 K.

During the experiment, Hecht and his colleagues found that when the tip–tuning-fork system was immersed in superfluid helium at 1.8 K, random fluctuations of the resonance frequency occurred independent of the tip-to-sample distance. The variation was ~150 mHz. (Typically, the resonance frequency fluctuations of the tuning-fork sensor were at an amplitude of $\Delta\nu$ ~5%–10% of the full width at half-maximum of the resonance of the tip–fork system.) Nevertheless, the researchers could collect data in the contrast phase mode by making the difference between set point and free vibration value larger than the fluctuation amplitude. This achieved a gap-width feedback.

Few reports exist of this tip-to-sample distance regulation for scanning near-field optical microscopy with the entire setup immersed in superfluid helium, according to the researchers. Reasons behind the resonance fluctuations of the tuning fork in superfluid helium still aren't clear, but Hecht's group speculates that a temperature fluctuation in the superfluid helium phase may be the cause. (*Rev. Sci. Instrum.* **2002,** *73,* 2937–2941)

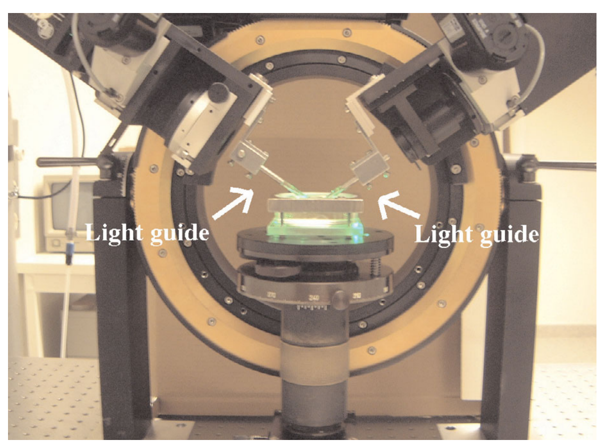
Image not availble for use on the Web.

Topographic imaging in superfluid helium at 1.8 K of a silicon line grating sample. Weakly bound dust particle at bottom right of image shows the scan process can be controlled while interaction forces are in a favorable regime. (Adapted with permission. Copyright 2002 American Institute of Physics.)

Re-inventing ellipsometry

Optical methods may seem to be "yesterday's news", but here is one that is getting some fresh headlines. Jan-Willem Benjamins and co-workers at Lund University (Sweden) present the design and theory for a new ellipsometer, which can handle measurements at the liquid–liquid and solid–liquid interfaces. Current designs require a special setup to make such measurements and have to deal with light passing through air, which introduces an unwanted contribution from the air–liquid interface.

Ellipsometers measure changes in the intensity and polarization of reflected light, which can be used to determine surface properties on a timescale of seconds. In their redesigned ellipsometer, the researchers add two light guides—one on the laser arm and the other on the detector arm—that automatically adjust to the angle of incidence. In addition, the design allows for smaller windows on the light guide, which reduces birefringence. The setup is also less sensitive to optical errors arising from thermal and mechanical stresses. (*Langmuir* **2002,** *18,* 6437–6444)



The optical components hang down from the laser and detector arms, giving more clearance for a greater range of angles of incidence.