SNOM: Photonics in the Scale of Nanometers

Chi Chen
Research Center for Applied Sciences, Academia Sinica, Taipei, 115, Taiwan.
chenchi@gate.sinica.edu.tw

With the inventions of scanning tunneling microscopy (STM) and atomic force microscopy (AFM), individual atoms can now be resolved in real-space through mapping tunneling current or interaction force. In the field of optics, although the photon-matter interaction starts at the length scale of sub-nanometers, the wave nature of photons generally limits our resolution to hundreds of nanometers. Scanning near field optical microscopy (SNOM) probes this interaction or its spectroscopic properties at very short probe-sample distance before the light is diffracted. This breaks the "diffraction limit" and provides unprecedented spatial resolution in optics.

In this talk, four different ways of SNOM will be presented: STM tunneling electron induced electroluminescence (STM-EL), STM based tip-enhanced Raman spectroscopy (STM-TERS), AFM based aperture near-field microscopy (a-SNOM), and AFM tip scattering microscopy (s-SNOM). The spatial resolution ranges from sub-nanometer to tens-of nanometers depending on the origin of the optical interactions and the characters of the near field probes.