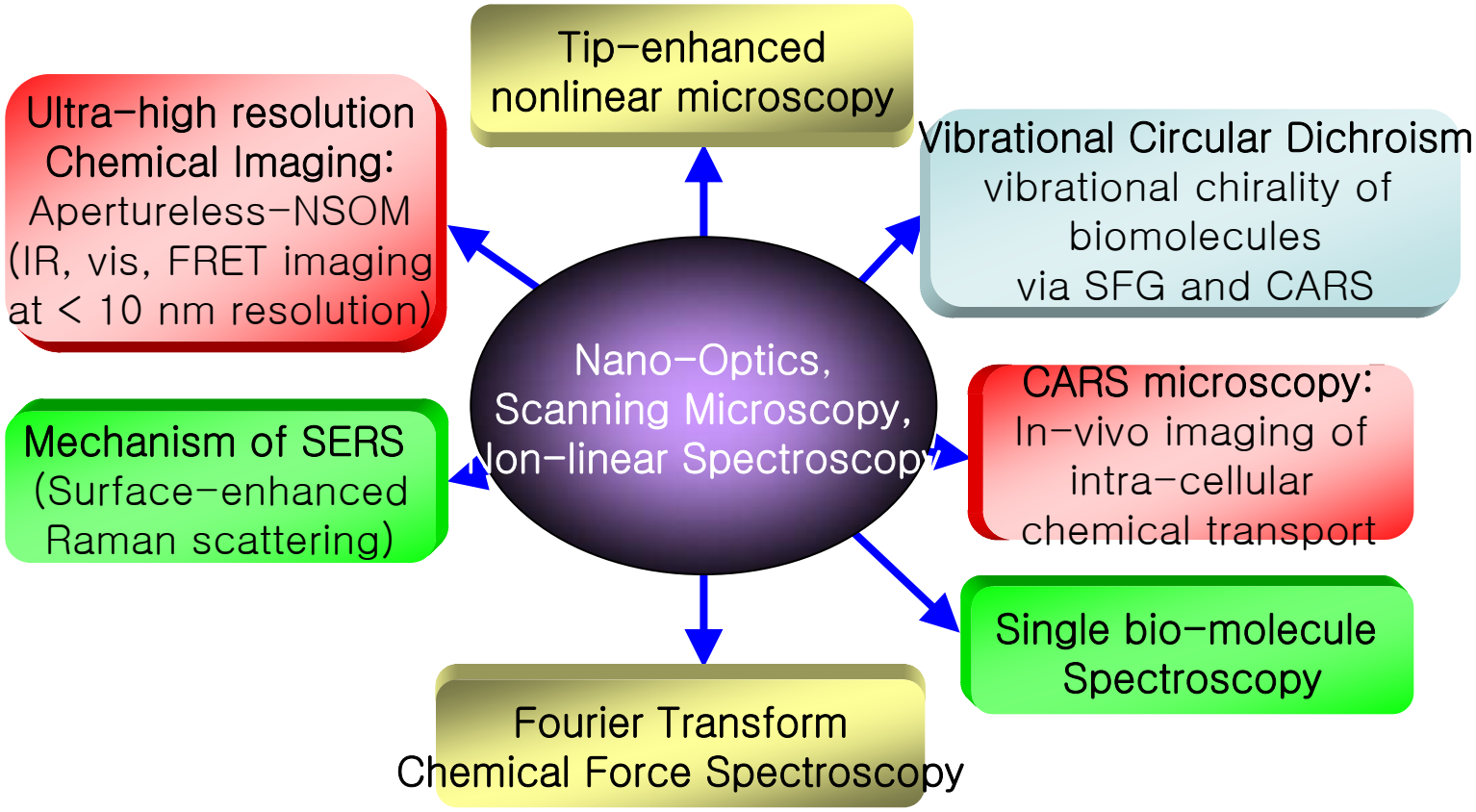
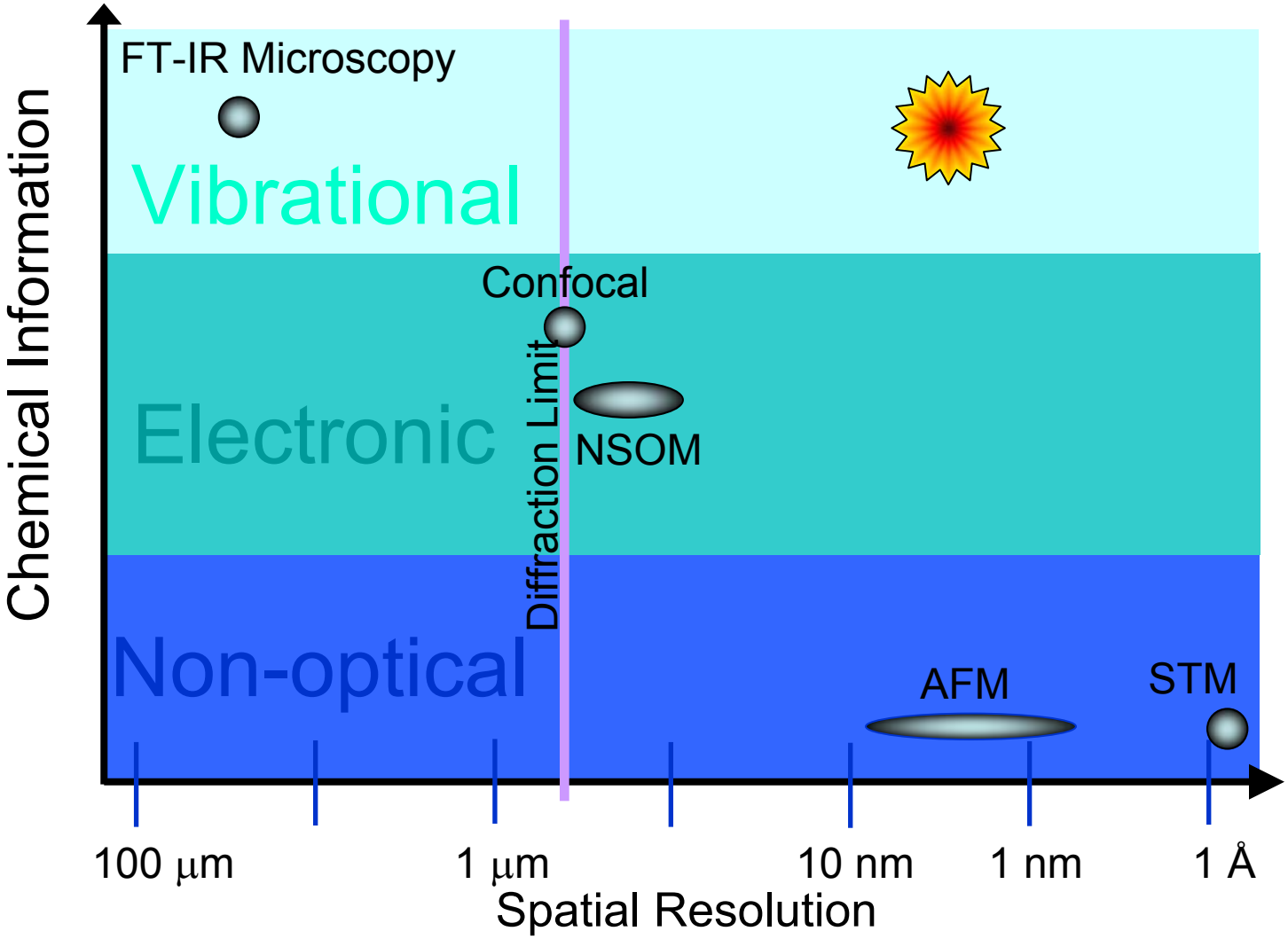
Molecular Nano-Optics / Chemical Imaging Lab

Zee Hwan Kim

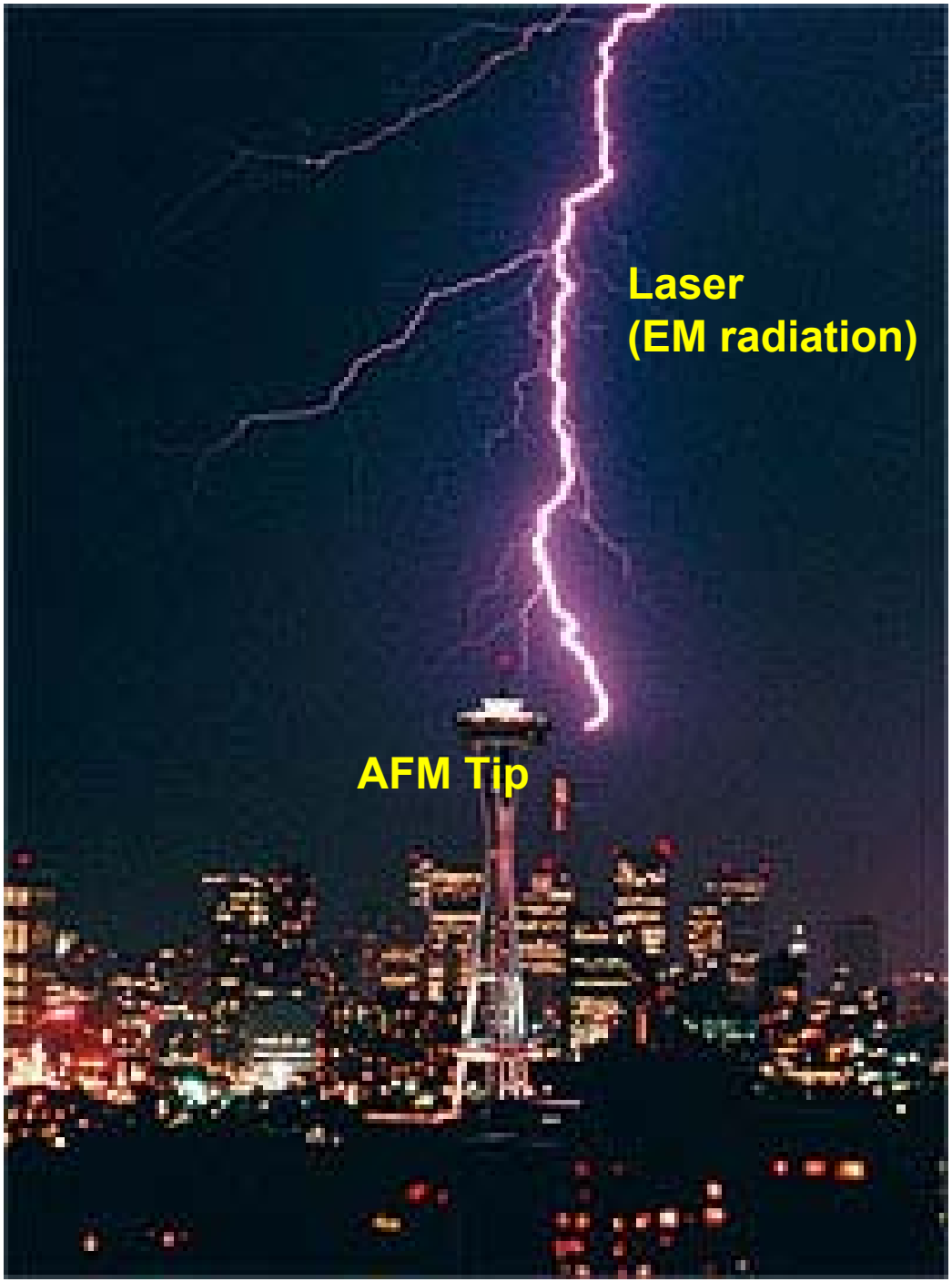
Department of Chemistry, Korea University



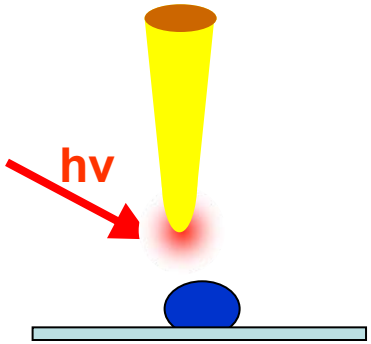
Microscopy and Spectroscopy



Why is it so difficult to build a High-Resolution Chemical Microscope ?


Laser
(EM radiation)
AFM Tip

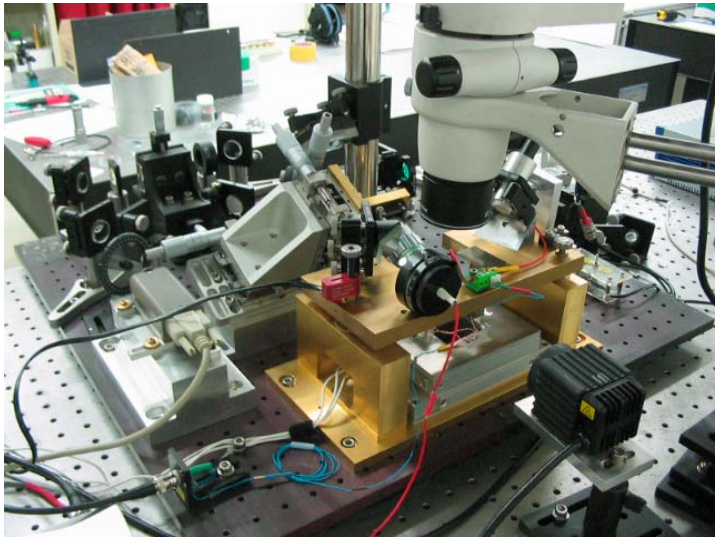
Tip-Enhanced Spectro-Microscopy, (Apertureless NSOM, ANSOM)



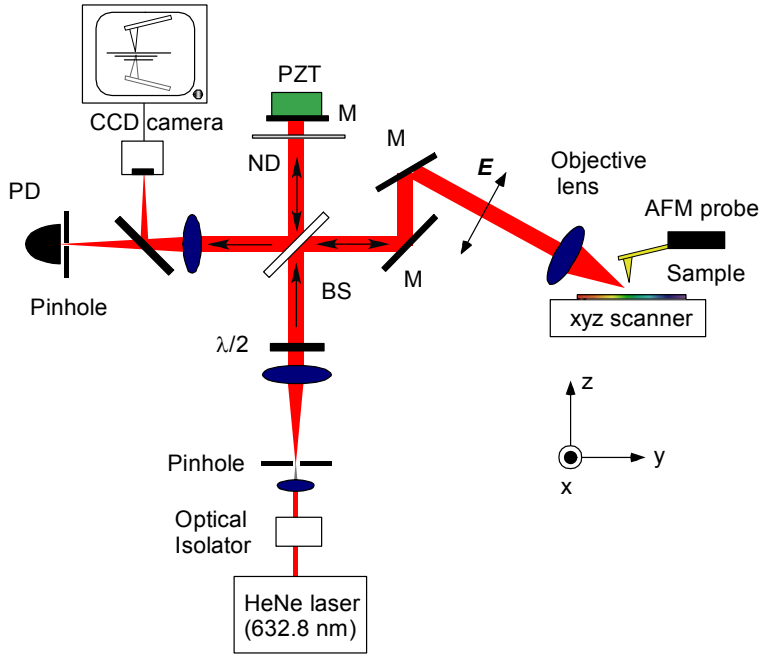
Promises:

-Resolution limited only by the tip-sharpness

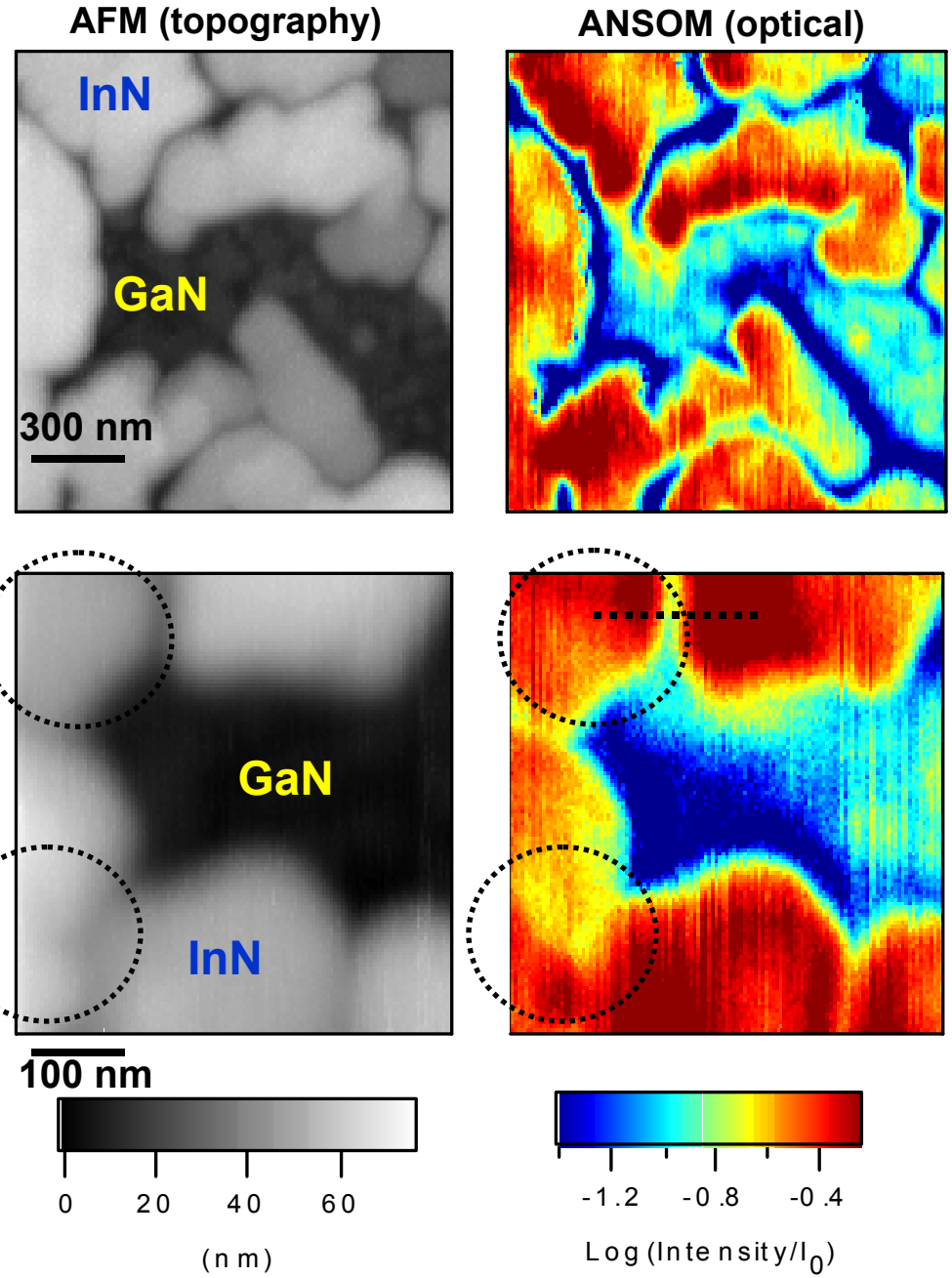
-Wavelength-independent (UV to THz)



Apertureless NSOM at Korea University



ANSOM: Dielectric Mapping



- **Identification** of InN and GaN islands
  Local refractive index change
  ***n*(InN) = 2.8**
  ***n*(GaN) = 1.5**

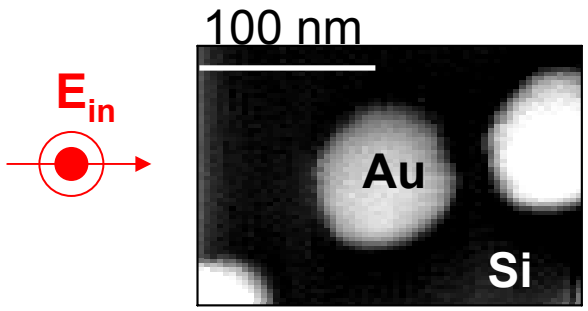
- **Local dielectric inhomogeneity** in InN islands:
  Local crystal strain and defect?
  Stacking fault?

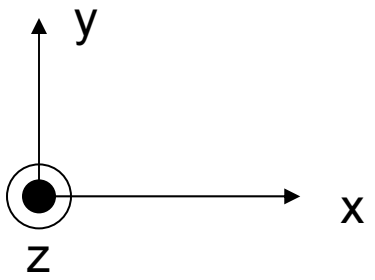
- **Spatial resolution: better than 15 nm**

Kim, Liu, and Leone *J. Phys. Chem.* B **109**, 8203 (2005)

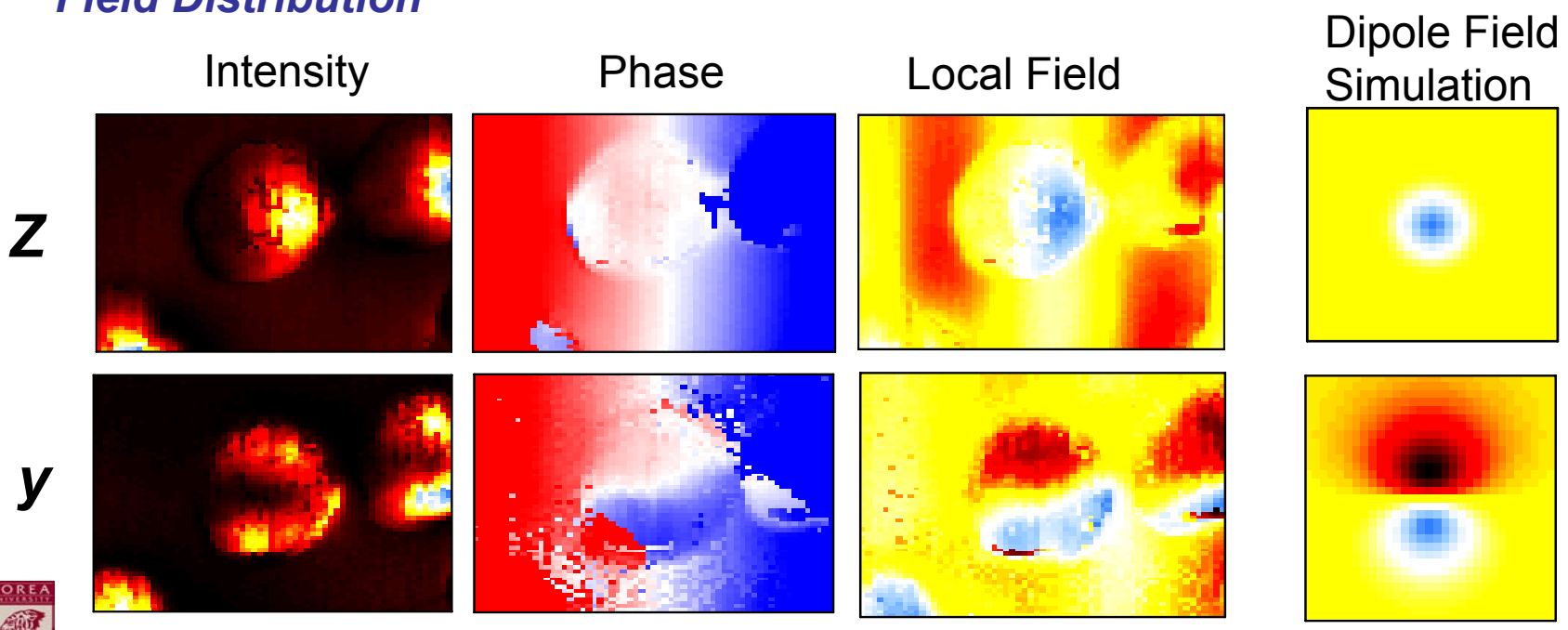
ANSOM:
Phase-Sensitive Plasmonic Field Imaging

Topography





Field Distribution



Kim and Leone, unpublished (2005)

ANSOM: Vibrational Imaging of monolayers

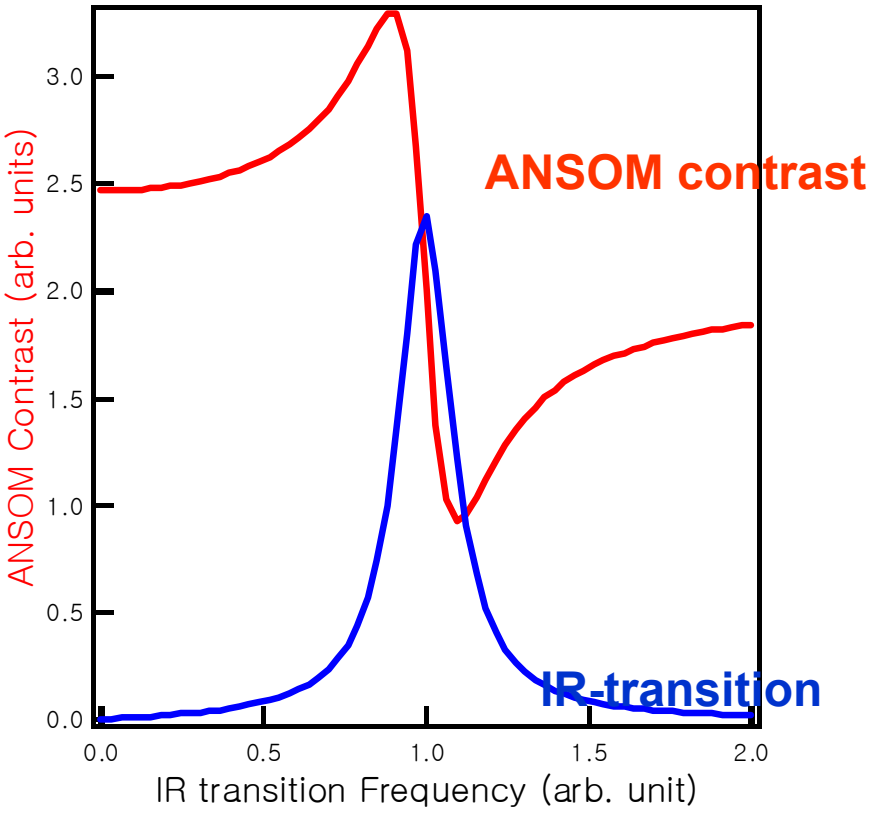
Kramers-Kronig Relation:

Absorption coefficient

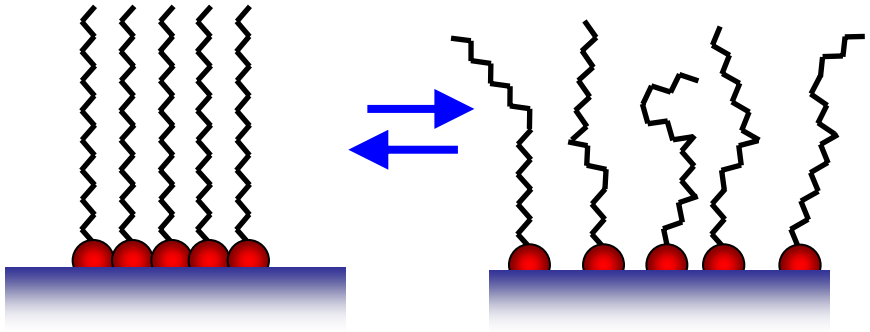
$$k(\omega) = \frac{2\omega}{\pi}\int_0^\infty \frac{n(\omega')-1}{\omega'^2-\omega^2}d\omega'$$

Refractive index

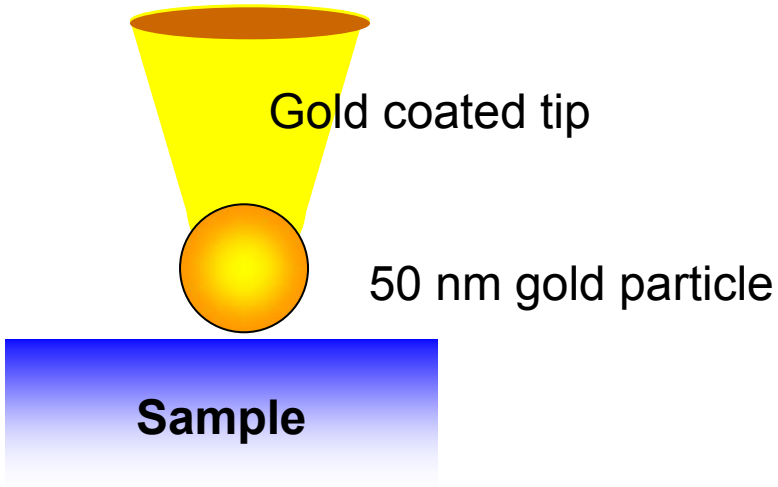
$$n(\omega) = n_\infty + \frac{2}{\pi}\int_0^\infty \frac{\omega' k(\omega')}{\omega'^2-\omega^2}d\omega'$$

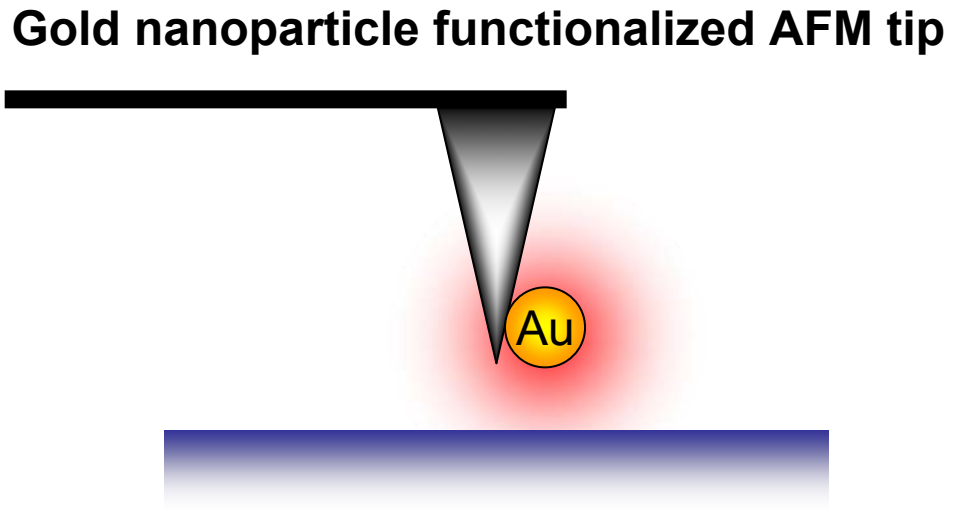


Liquid Condensed (LC) **Liquid Expanded (LE)**

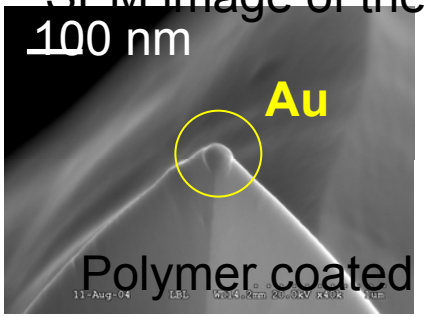


ANSOM Imaging with a Gold Nanoparticle antenna





SEM image of the tip



- Test of fundamental assumptions in ANSOM
- Fabrication of alternative "optically active" probes