

NanoPhotonics and Near-field Optics Group



**NPNO group:** Research projects in **plasmonics** and **silicon photonics**

**Overall goal:** investigate nanostructured materials that give new functionality

**Nanophotonic device fabrication**

- electron beam lithography
- thin film deposition

**Optical analysis of nanophotonic structures**

- Near-field Scanning Optical Microscopy
- Leakage radiation microscopy

**Nanophotonic device simulation**

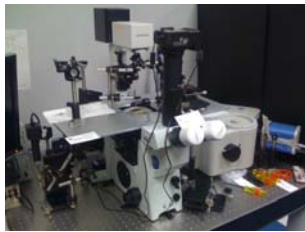
- Full-field electromagnetics simulation code
- Time domain and frequency domain

Positions available in [silicon compatible plasmonic devices](#)

Kik group: Nanophotonics and Near-field Optics

<http://kik.creol.ucf.edu>

NanoPhotonics Characterization Lab



Leakage radiation microscope  
Visualize plasmon propagation



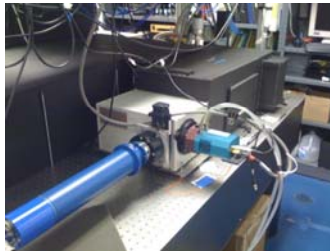
Near-field microscopy  
Sub-diffraction limit imaging



Fiber coupled microscope  
Single particle spectroscopy



Variable temperature spectroscopy (10K-800K)



Photoluminescence spectroscopy



Waveguide analysis (NIR)

Kik group: Nanophotonics and Near-field Optics


<http://kik.creol.ucf.edu>

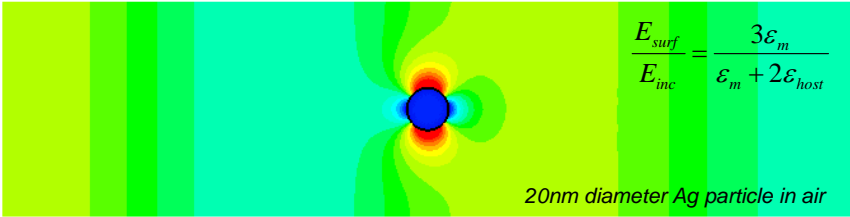
### Enhancing local fields using surface plasmon resonance

Spherical metal particles support **localized surface plasmons**  
 Collective electron oscillations

Strong near-fields at **plasmon resonance frequency**  
 Typically in UV-visible region of the spectrum

Resonance frequency depends on :  
 - Metal / Dielectric / **Local environment** / Size / Shape





$$\frac{E_{surf}}{E_{inc}} = \frac{3\epsilon_m}{\epsilon_m + 2\epsilon_{host}}$$

20nm diameter Ag particle in air

View PowerPoint file in presentation mode to see animation (<http://kik.creol.ucf.edu/talks.html>)

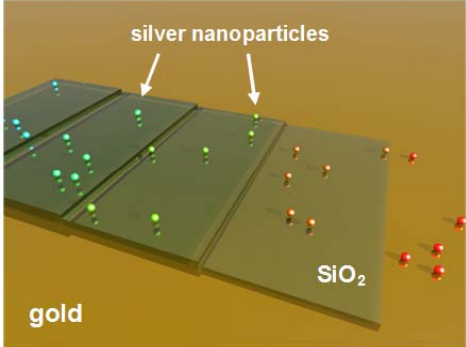
Kik group: Nanophotonics and Near-field Optics
<http://kik.creol.ucf.edu>

### Example project: plasmon resonance tuning

Metal nanoparticle plasmon resonances:

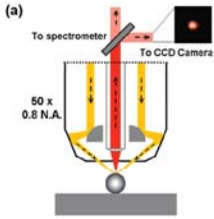
Optical resonances that lead to  
 - enhanced fields, enhanced optical nonlinearity, ...

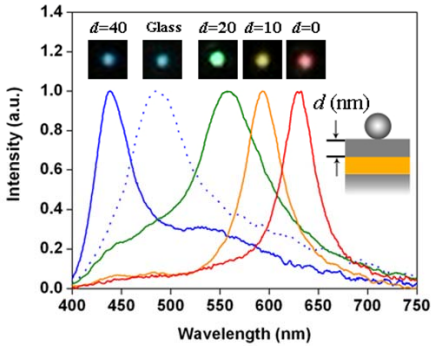
Used for biosensing, light harvesting, optical tracers, ...



Hu et al. (<http://qoo.qf/TfCN>)

(a)



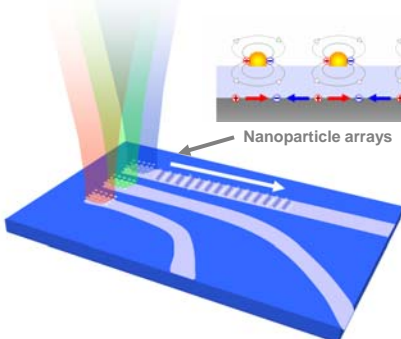


d (nm)	Resonance Wavelength (nm)
40	~440
20	~560
10	~610
0	~640

Kik group: Nanophotonics and Near-field Optics
<http://kik.creol.ucf.edu>

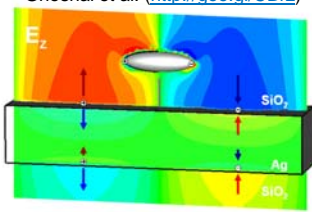
**Example project: nanoparticle based surface plasmon coupler**

**Goal:** efficiently excite surface plasmons (SPs) using resonant nanoparticle arrays



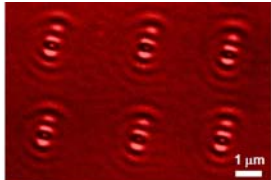
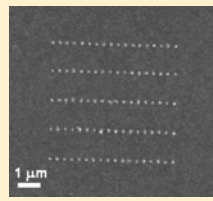
Nanoparticle arrays

Ghoshal et al. (<http://goo.gl/CBfL>)



3D finite element simulation showing surface plasmon excitation using silver nanoparticles

Webb-Wood et al. (<http://goo.gl/lKV2>)

Atomic force microscopy of e-beam generated Ag particles

Darkfield microscopy showing blue plasmon resonance


Kik group: Nanophotonics and Near-field Optics <http://kik.creol.ucf.edu>

**What can you expect:**

- Cutting edge experimental work (nanolithography, near-field microscopy, ...)
- High-end equipment to do your work
- Work in a new and active area of optics and photonics
- Weekly group meetings
- Weekly literature meeting in the bookstore
- Regular visits to conferences
- Lots of fun science!

More information on the website:  
<http://kik.creol.ucf.edu>

> Kik Group      College of Optics and Photonics      UCF



**Laboratory**

The study of nanophotonic structures requires an array of dedicated equipment, including various light sources, detectors, electronics, nanopositioning equipment, software, and more. This section gives an overview of some of the tools currently

Kik group: Nanophotonics and Near-field Optics <http://kik.creol.ucf.edu>