Functional Photonics:

Study of novel nano-optical/photonic functions originating from the interaction between photon and nanostructued materials (2014-2016)

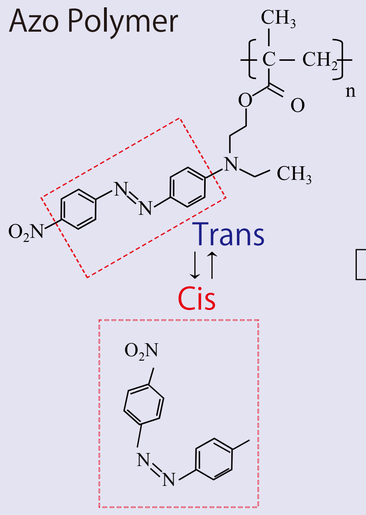
Principal Researcher at Osaka University: Prof. Satoshi Kawata

Professor: Dr. Zouheir Sekkat[1,2]

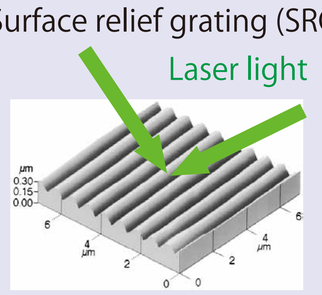
[1]Director of the Optics & Photonics Center, MAScIR, Morocco,
University of Mohamed V, Rabat, Morocco and [2]Osaka University (cross appointment).

Light-Induced Polymer Movement of Azo-Polymers toward Light-Driven Nano Machine

Azo Polymer



Surface relief grating (SRG)



Kim et al, APL (1995)

Surface deformation pattern reflects the incident light polarization state and intensity distribution.

Polarization dependence

- P+P (Intensity grating) ⇨ Recorded
- S+S (Intensity grating) ⇨ Not-recorded
- P+S (Polarization grating) ⇨ Recorded

Photoisomerization & molecular orientation of azo-benzen are strongly related.

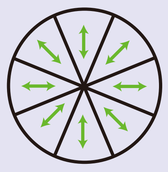
Features

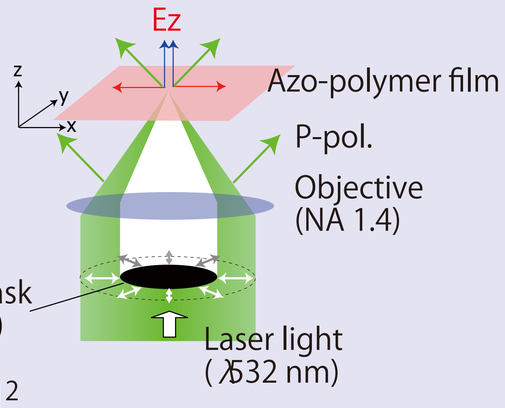
- Direct inscription (no wet process)
- Optically erasable by irradiation with circularly polarized light (Heating above the glass transition temperature (Tg))

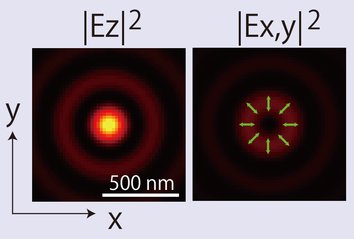
Applications

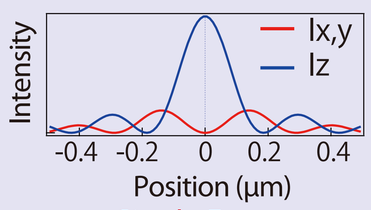
- Holographic memory
- Optical lithography
- 2D photonic crystal
- Sub-diffraction imaging of optical near-field
- Opto-mechanical function

Radial Polarization

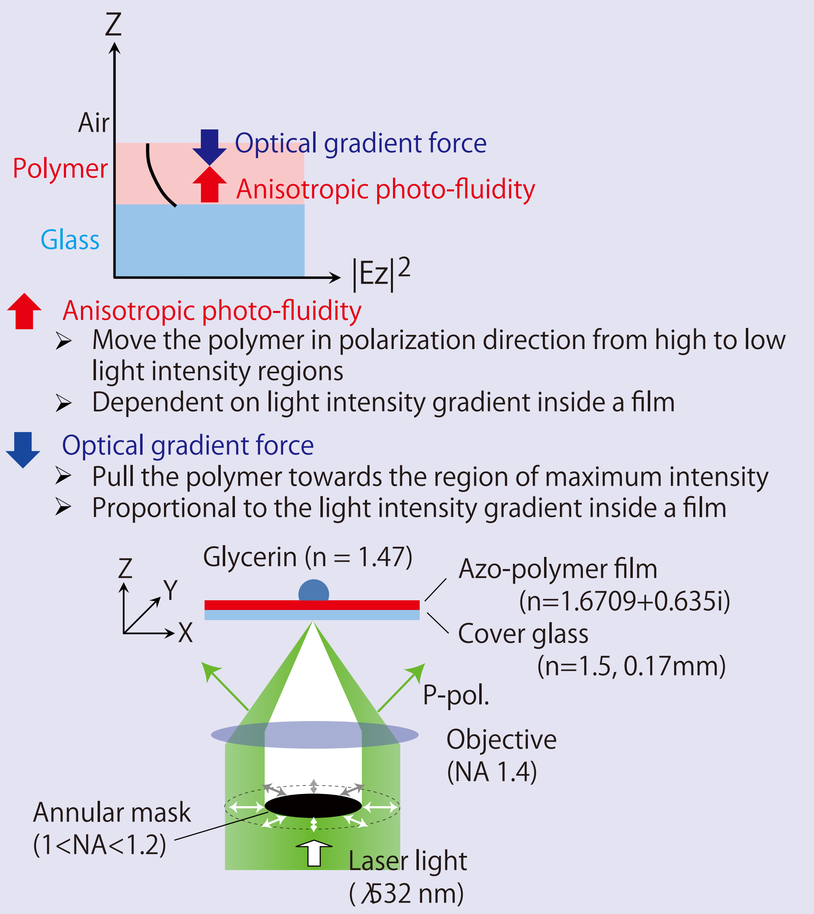








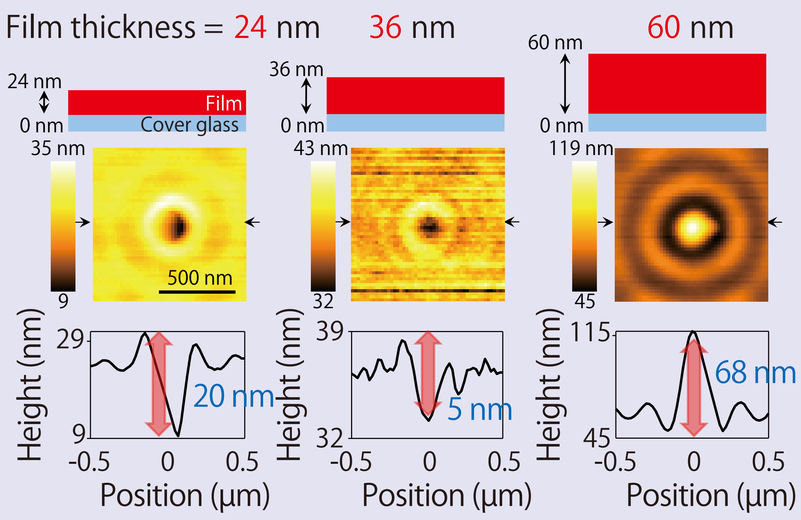
Single Ez spot



Anisotropic photo-fluidity
- Move the polymer in polarization direction from high to low light intensity regions
- Dependent on light intensity gradient inside a film

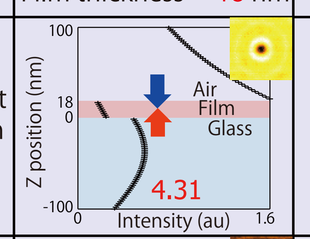
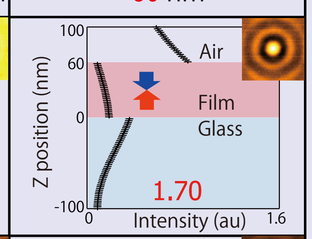
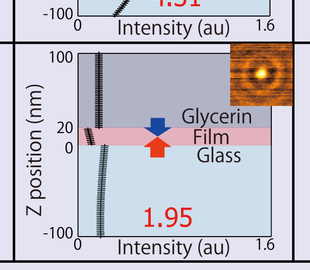
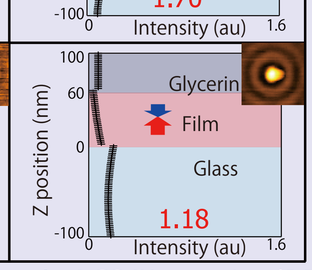
Optical gradient force
- Pull the polymer towards the region of maximum intensity
- Proportional to the light intensity gradient inside a film

Film thickness = 24 nm 36 nm 60 nm



Ishitobi et al., ACS Photonics (2014)

- Strong film thickness dependence
- Polymer migrates in polarization direction (z-axis)

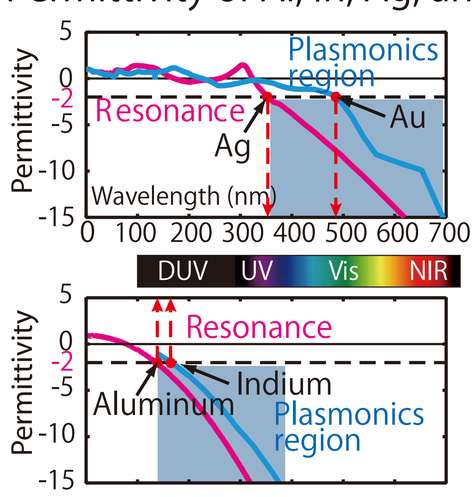
	Film thickness = 18 nm	60 nm
Without glycerin (Air)		
With glycerin		

Ishitobi et al., ACS Photonics (2014)

UV Plasmonics

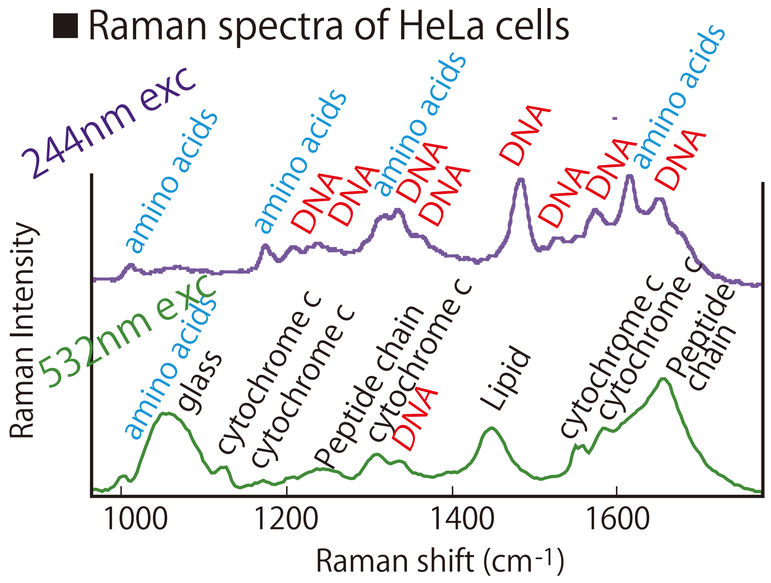
UV––frontier of plasmonics

■ Permittivity of Al, In, Ag, and Au



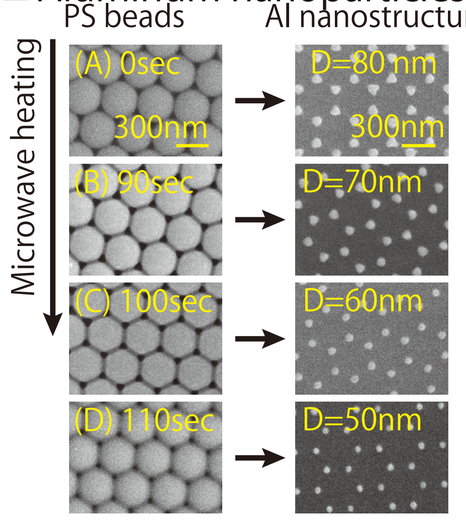
Why DUV?

■ Raman spectra of HeLa cells

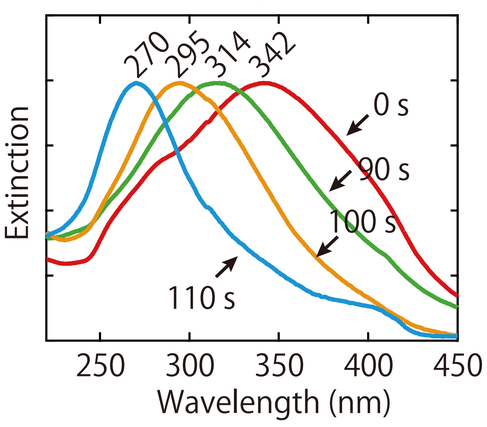


DUV-LSPR by aluminum nanoparticles

■ Aluminum nanoparticles fabricated with PS masks



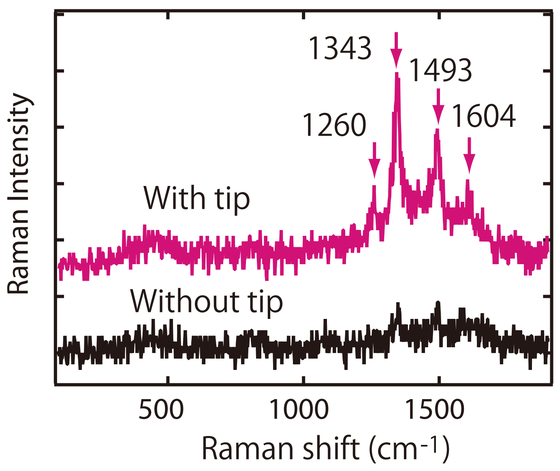
■ Extinction spectra



Taguchi & Kawata, APL 101, 081110 (2012)

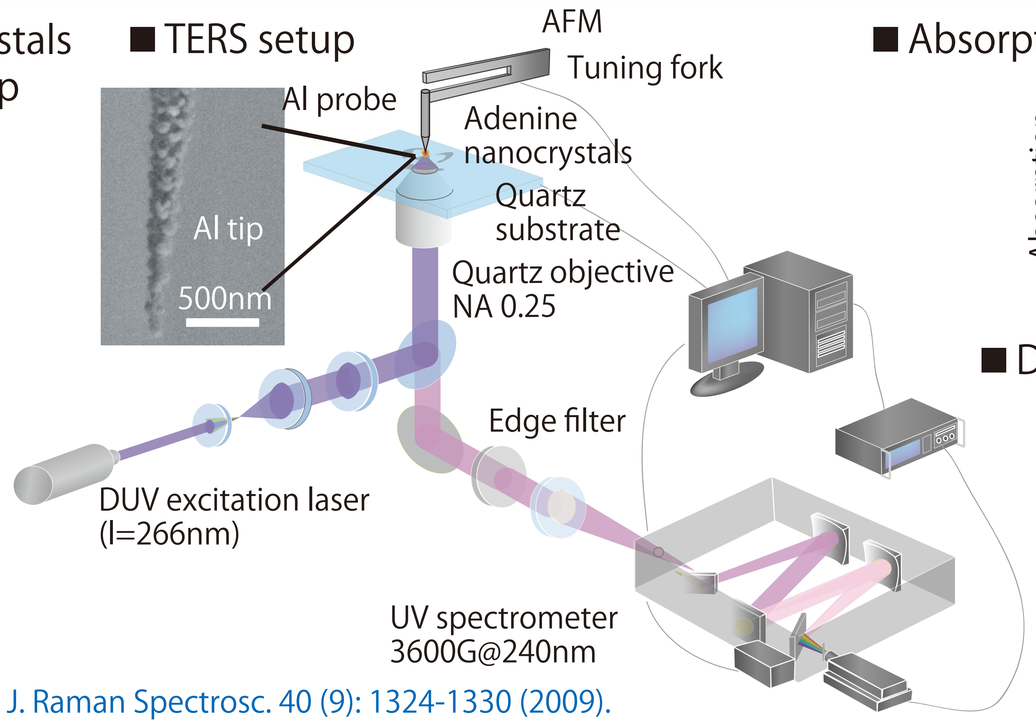
DUV-TERS and SERS

■ Raman spectra of adenine nanocrystals measured w/ and w/o aluminum tip



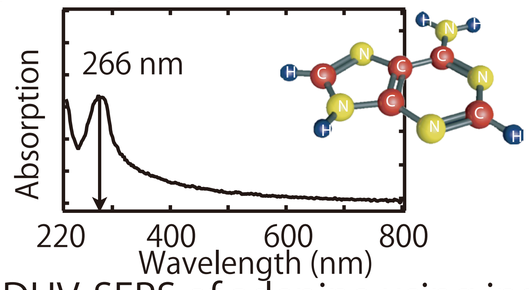
- Excitation: 180μW@266nm; Exposure: 60s
- Raman enhancement factor (EF) ~ 1.3x10^3

■ TERS setup



Taguchi, et al. J. Raman Spectrosc. 40 (9): 1324-1330 (2009).

■ Absorption spectrum of adenine



■ DUV-SERS of adenine using indium grains

Kumamoto, et al. ACS Photon. 1: 598-603 (2014).