PURDUE UNIVERSITY | Chemistry COLLEGE OF SCIENCE

The Mueller Lecture

Wednesday, April 21, 2021

Seminar 12:30 PM via Zoom
Reception 1:30-2:30 via Zoom

https://purdue-edu.zoom.us/j/99648501847?pwd=b1hhcXlaNzJOQTZJUEluRUIxeVFudz09
Meeting ID: 996 4850 1847 Passcode: Mueller

Michel Orrit
MoNOS, Huygens-Kamerlingh Onnes Laboratory
Leiden University, Netherlands

"Single Molecules and Single Gold Nanoparticles in the Spotlight"

Several optical methods give access to single molecules and single gold nanoparticles, whose strong interaction with light is mediated by their plasmon resonances: fluorescence (photoluminescence), scattering, absorption from photothermal contrast, refractive effects leading to shifts of the plasmon resonance, or plasmon-enhanced fluorescence of weak emitters. Fluorescence, the workhorse method in single-molecule studies, provides access to single chemical events such as the turnovers of single redox proteins [1]. Combined with near-field enhancement by plasmonic gold nanoparticles, enhanced fluorescence applies to very weak emitters such as dyes with quantum yields as low as 0.0001. Anti-Stokes photoluminescence of gold nanoparticles, enhanced by a plasmon resonance, provides their absolute temperature [2]. In recent years, single-molecule sensitivity has been reached by means of other optical techniques. Photothermal contrast can be sensitive enough to detect single photostable molecules or even photosensitive ones as single organic conjugated polymers. Photothermal microscopy can also provide quantitative circular dichroism data of single nanoparticle absorbers [3]. Plasmonic gold nanoparticles are sensitive to refractive index changes in their environment. Non-absorbing protein molecules can thus be detected individually through their optical polarizability only, without need for fluorescent or absorbing labels. The binding and unbinding of single protein molecules from the solution give rise to sudden absorption steps, opening micro-analytical applications and in-situ sensing. Similar experiments can be done on the fly on single diffusing nanoparticles [4].

[1] B. Pradhan et al., *Chem. Sci.*, **11** (2020) 763 .[2] A. Carattino et al., *Nano Lett.* **18** (2018) 874. [3] P. Spaeth et al., *Nano Lett.*, **19** (2019) 8934.

[4] M. Baaske et al., *ACS Nano* **14** (2020) 14212.