UNIVERSIDAD
ANDRES BELLO

Single Molecule Spectroscopy and its Applications to Nanoscience and Chemical Biology

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Universidad Andrés Bello
Av. República 399 sala R5-202

The course will consist of 20 h of lectures, and a final exam (2 h in class). Five different sections are identified. Section 1 will be based on standard Photochemistry books such as Modern Molecular Photochemistry of Organic Molecules. Section 2 will be based on the book Principles of fluorescence. Section 3 will be based on recent reviews on single molecule microscopy and setups. Sections 4 and 5 will be based on recent literature.

1. Introduction to Photochemistry and Photophysics (3 h)
    a. Jablonski diagram
    b. Singlets and triplets
    c. Chemical vs. physical processes
    d. Fluorescence and phosphorescence
    e. Energy Transfer, electron transfer and singlet oxygen sensitization

2. Fluorescent probes (3 h)
    a. Standard fluorophores
    b. Fluorescent proteins
    c. Emission quantum yield, absorption and brightness
    d. Intrinsic photostability and protocols to enhance emissive properties
    e. Fluorogenic probes, exploiting nonradiative pathways towards enhancement.

3. Microsocopy setup and sample preparation in single molecule (3 h)
    a. Microscope hardware
    b. Excitation sources. Lasers vs. lamps, single mode vs. multimode
    c. Wide field, Confocal and Total Internal Reflection (TIRF) microscopy

d. Fluorescence Lifetime Imaging (FLIM)
e. Detectors appropriate for single molecule studies. CCDs and APDs
f. Sample preparation, immobilization techniques.

4. Single Molecule Super resolution microscopy (3 h)
    a. Far field optical resolution, the gaussian profile and the centroid.
    b. FIONA (Fluorescence Imaging with One Nanometer Accuracy)
    c. Exploiting blinking, bleaching photoactivation and stimulated emission
    d. Concepts behind STORM (Stochastic Optical Reconstruciton Microscopy)
    e. 2D STORM and 3D STORM
    f. Concepts behind PALM (Photo-Activated Localization Microscopy)
    g. Concepts behind STED (Stimulated Emission Depletion microscopy)
    h. Concepts behind SOFI (Super-resolution Optical Fluctuation Imaging).

5. Applications of Single Molecule to chemistry and chemical biology (6h)
    a. Enzyme reactions
    b. Catalysis in zeolites
    c. Diffusion in polymer films
    d. Au nanoparticle catalysis
    e. Electrochemical reactions
    f. Photocatalysis studied via single molecule

Lectures: 20 h
Personal Study: 6 h
Final Exam: 2 h
Total Course-Time: 28 h
Literature:

- Modern Molecular Photochemistry of Organic Molecules. N. Turro, University Science Books, 1991.
- Principles of Fluorescence Spectroscopy. J. R. Lakowicz, 3ª Ed., Springer, 2006.

Informations:

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