2017/10/12(Thu.)-13(Fri)

【科目名 Course title】
「化学特別講義Ⅰ」Special Lecture on Advanced Chemistry Ⅰ

【科目番号 Course code】
35606-1101

【担当教員 Teaching staff】
Prof. Eric Olaf POTMA

【日時 Date and Period】
2017/10/12(Thu.)-13(Fri)
Lecture 1 (10:25 - 12:10, Oct 12),
Lecture 2 (13:00 - 14:45, Oct 12),
Lecture 3 (14:55 - 16:40, Oct 12),
Lecture 4 (10:25 - 12:10, Oct 13,
Lecture 5 (13:00 - 14:45, Oct 13),
Zasshikai Lectureship talk (15:00 - 16:00)

10/13(金)15：00～は雑誌会セミナーを開催します。
授業履修者は、そのままご参加ください。
Zasshikai seminar will be held after the class on Fri.13th at 3:00pm.
Participants are recommended to take this seminar as well.
(雑誌会セミナーHP)
https://www.chem.s.u-tokyo.ac.jp/events/jp/jp-seminar/474

【教室 Classroom】
10/12(Thu.)-13(Fri)：化学本館 4 階講義室 4F Lecture room, Chemistry Main Bldg.

【シラバス syllabus】
(Schedule)

Lecture 1: Coherent Raman Scattering: Paragon of Nonlinear Optics
In this Lecture the topic of nonlinear optical light matter interactions is introduced in an historical context, with the coherent Raman effect as a prime example. A detailed description of coherent Raman scattering (CRS) is given, both in a classical and quantum context. The key capabilities of CRS are highlighted and summarized.

Lecture 2: Vibrational Coherences: Windows to Molecular Dynamics
The property of vibrational coherences, which plays a central role in nonlinear optical spectroscopy, is introduced. Several CRS techniques are descripted that can directly resolve the evolution of vibrational coherences and retrieve the dynamics of molecules at ultrafast timescales. Several representative examples of CRS spectroscopy studies of molecular ensembles in solids and liquids are discussed.

Lecture 3: Coherent Nonlinear Optics at the Micro-Scale
The concept of focusing light to sub-micron sized volumes is discussed in the context of CRS and other nonlinear optical techniques. Several new phenomena that are unique to CRS in tight focal volumes are highlighted and their importance in CRS imaging is underlined. The notion of focal distortions due to sample scattering is introduced and several remedies are described.

Lecture 4: Coherent Vibrational Microscopy of Tissues and Cells
An overview is given of CRS microscopy applications in biology and biomedical sciences. The unique properties of CRS microscopy and related techniques are pointed out, and a prospective is presented on potential implications of clinical CRS technologies.

Lecture 5: Coherent Nonlinear Optics at the Nano-Scale
Recent developments have made it possible to confine light to nanoscopic volumes, and have opened opportunities for conducting CRS interactions at the sub-wavelength scale. The possibility of super-resolution CRS microscopy is discussed, along with near-field CRS imaging and spectroscopy techniques.

Zasshikai Lecture: Coherent Raman Scattering of Single Molecules
The vibrational motion of a chemical bond constitutes the basis of chemical change as it forms the essential dynamics involved in the making and breaking of a bond. Much is known about chemical bond vibrations but some key aspects of vibrational dynamics are not well understood. Under ambient conditions, actual vibrational motions are subject to intramolecular conformational changes and intermolecular collisions, giving rise to stochastic behavior. These stochastic vibrational trajectories of individual bonds cannot be seen, unless they are resolved on the single molecule level. Such measurements are extremely challenging. Nonlinear coherent Raman scattering (CRS) measurements have been successful in resolving bond vibrational dynamics in molecular ensembles, but CRS measurements have traditionally been unsuited for single molecule experiments. The latter is due to the weakness of the Raman effect and the general lack of sensitivity. Recent work suggests that the plasmonic enhancement effects used in surface-enhanced Raman scattering (SERS) can also be used to boost the sensitivity of CRS experiments. In this presentation, we will discuss the use of plasmonic amplifiers in CRS spectroscopy and microscopy. Several successful experiments will be highlighted, among which surface-enhanced coherent anti-Stokes Raman scattering (SE-CARS) of single molecules.