UCLA College | Physical Sciences Chemistry & Biochemistry

SPECIAL CHEMISTRY SEMINAR

Prof. Alex Clark

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1:30 PM | Young Hall 2033

Molecular Spectroscopy via Nonlinear, Quantum, and Coherent Interference

Depending on your perspective, molecules can be seen as a nuisance or as a resource. Greenhouse gas molecules such as carbon dioxide and methane are causing global climate change, which is causing rapid changes in temperature that threaten to increase sea levels and destabilise global ecosystems. Meanwhile, certain molecules can be used as catalysts for important chemical reactions, hydrogen molecules promise to be a source of clean fuel for combustion, and single molecules can be useful as photon sources in quantum technologies. In all cases, developing techniques to characterise molecules and their interactions is important. I will present three molecular spectroscopy techniques that all use forms of optical interference. The first is nonlinear interference which allows imaging and spectroscopy at mid-infrared (mid-IR) wavelengths, where many molecules have distinct vibrational absorption bands, while only ever needing to detect visible or near-infrared light. I will present our recent work on optimising this technique and using it for performing fast detection of methane. The second technique uses quantum interference of photons emitted by a single organic molecule. I will present our work on preparing organic crystals doped with dibenzoterrylene molecules, and experiments showing how two-photon interference can be used to characterise the coherence of the emitted photons, which is related to the interactions between a molecule and its environment, using both pulsed and continuous excitation. The third and final technique uses coherent interference between laser light and photons scattered by a single molecule in a nanophotonic waveguide. I will present our work on designing, fabricating and characterising silicon nitride integrated photonic waveguides with nanometric gaps between them, where we introduce organic molecules via micro-capillaries. The interference of the coherently scattered photons from a single molecule and the residual laser light in the waveguide can be used to characterise the coupling of the molecule to the device. If time permits, I will discuss our next steps to enhance this coupling using nanophotonic cavities.

Please contact letts@chem.ucla.edu for additional information.