

5th International Conference and Exhibition on

LASERS, OPTICS AND PHOTONICS

November 28-30, 2016 Atlanta, USA

Fragmentation dynamics of methane induced by femtosecond laser pulses

Viviane Costa Felicissimo
Federal University of Sergipe, Brazil

The conversion of methane to value-added chemical products such as alcohols, aldehydes and higher alkanes is one of the greatest challenges of these last years. Methane is the most inert of hydrocarbons and the principal constituent of the natural gas. It has been verified that the vibrational excitation of methane can play an important role in activating this inert molecule. In the last years, significant progress has been made by Richard N Zare and co-workers toward understanding of the role of vibrations in the chemical reactions with methane. The interest of promoting infrared (IR) excitation in resonance with a selected vibrational and the rapid advances in the technology of femtosecond pulsed laser have stimulated an increasing number of studies about the fragmentation of methane induced by ultra-short laser pulses. The efficiency of using femtosecond laser pulses to guide and follow the nuclear motion, breaking or forming selected bonds during a chemical reaction has been studied for many years. The first to use femtosecond laser technology to solve problems in chemistry and biology was Ahmed H Zewail in the mid-80s. With the interaction of high intensity ($\sim 10^{12}$ - 10^{14} W/cm²) femtosecond laser pulses, molecules can undergo a variety of dynamical processes, in which neutral fragmentation can occur. In the present work, we investigate theoretically, through ab-initio molecular dynamics simulations, the chemical reaction of dissociation of methane induced by intense femtosecond IR pulses. An alternative mechanism based on the rectification of the electric force, demonstrated at first by Faris Gel'mukhanov et al, is employed to explain the neutral fragmentation of C-H bond in methane. A strong IR laser field induces a periodical charge transfer between different parts of the molecule, resulting in the rectification of the Lorentz force. This creates the opportunity to produce a direct mechanical action of the light on atoms or group of atoms in the molecule.



felicissimo@ufs.br

Dynamics of plasmonic nanolasing: From strong coupling to stopped-light lasing and surface-plasmon polariton condensation

Ortwin Hess
Imperial College London, UK

Recent progress in nanophotonics and metamaterials physics is now allowing us to 'look inside the wavelength' and exploit active nanoplasmonics and metamaterials as a new route to quantum many-body optics on the nanoscale. At the same time, lasers have become smaller and smaller, reaching with the demonstration of plasmonic nanolasing, scales much smaller than the wavelength of the light they emit. Here we discuss recent progress in the study of quantum emitters and quantum gain in nanoplasmonic systems and deliberate on approaches. We combine classical and quantum many-body theory and simulation to describe and model the spatio-temporal dynamics of the optical near field and plasmon polaritons coupled with quantum emitters in nano-plasmonic cavities. We reveal the mechanisms that recently have experimentally allow us to reach the strong coupling regime at room temperature and in ambient conditions. Moreover, it will be demonstrated that applying the nanoplasmonic stopped-light lasing principle to surface-plasmon polaritons (SPP) allows the realization of trapped/condensed non-equilibrium surface-plasmon polaritons at stopped-light singularities, providing an entry point to SPP-condensation.

o.hess@imperial.ac.uk