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COHERENT RAMAN MICRO-SPECTROSCOPY IN THE LIGHT OF ULTRAFAST LASER EXCITATION

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Since its first observation in 1928, the spontaneous Raman effect has evolved into one of the most popular analytical characterization tool in diverse areas, including biology, geology, semiconductor, materials and polymer science. Using ad-hoc designed sequences of ultrashort optical pulses allows first stimulating and subsequently detecting inter-atomic vibrations via the coherent version of the Raman effect, enabling superior temporal precision and acquisition speed for time-resolved and imaging applications, respectively.

Starting from the principles of Raman micro-spectroscopy, I will present two recent experimental realizations developed in our group building on the coherent Raman effect. The first, so called Femtosecond Stimulated Raman Spectroscopy, is a pump-probe technique which allows recording snapshot of ultrafast atomic dynamics with an unprecedented combination of temporal and structural resolutions, which can be ultimately used for the making of molecular movies. The second, based on Coherent Anti-Stokes Raman Scattering, allows for video-rate imaging of biological samples with chemical selectivity as well as for microscopic characterization of low dimensional materials. The capabilities of the two approaches will be illustrated by a few recent applications, including the visualization of energy flow pathways within biological macromolecules, the effect of drugs on hepatic lipid metabolism, the non-linear vibrational imaging of graphene layers.