Thermoplasmonic imaging: Free space propagation and confinement of 100-fs plasmons pulses in metallic structures

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Recent advances in nano-photonics lead to extreme light confinement (ELC) and light manipulation. This progress has spawned a variety of new important technological possibilities for the efficient delivery, control and manipulation of optical radiation on the nanoscale. Although the physical principles of ELC with plasmons i.e. nano-focusing has been clearly demonstrated in several studies, further fundamental studies are needed to optimise these processes and control losses in plasmonic devices for viable technological applications.
This talk will introduce the coupling of the ELC with the electron and lattice dynamics in metals. In one of our recent works, we have demonstrated the capability to image and film plasmon propagation in a metallic film. We probed the hot electrons heated by the plasmon dissipation via a Time Domain Thermoreflectance (TDTR). Figure 1 describes an appropriated designed plasmonic device where plasmons can be concentrated at the apex. TDTR is a unique tool to reveal and study energy transport processes induced by ELC in nanometric devices that have not been explored so far in low-dimensional systems.
We have detected and imaged the hot carriers generated in the hot spot and exploited the mechanism of plasmon absorption in metals for the generation of hot carriers at femtosecond time scale, and this energy conversion was measured with femtosecond pump-probe technique. Femtosecond plasmon pulses will be launched and probed over hundreds of femtoseconds through the permittivity variations induced by the hot-carriers.

References

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Figures

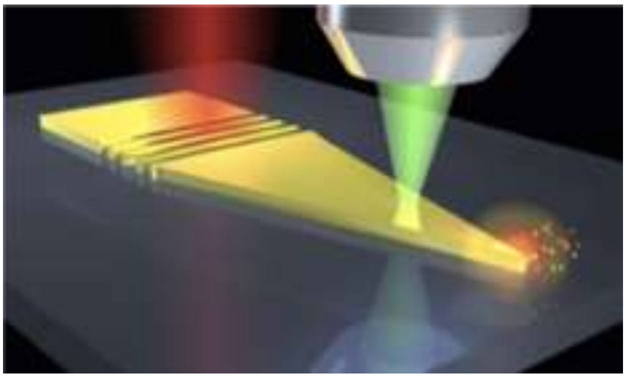

Figure 1: *Schematic illustration of the experimental setup. The grating is shined by the red beam launches a plasmon focused at the tip apex producing hot carriers. The green laser probes the hot electrons during the focusing process.*