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CV/ biography

Stefan Dilhaire is Professor at University of Bordeaux. At LOMA (Laboratoire Ondes et Matière d'Aquitaine) Stefan Dilhaire's group studies mutual interaction of heat, light and electricity in micro-systems and nano-materials and its applications in renewable energy, in microelectronics, in nano-plasmonics, and biology.

ULTRAFAST ENERGY TRANSFER IMAGED BY TIME DOMAIN THERMOREFLECTANCE

The reduction of the size of nano-objects or nano-materials down to the nanoscale leads to strong modifications of its transport properties depending then on its size, shape, structure and obviously on its environment. Carrier confinement combined to interface effects gives rise to new transport properties. That is the case in absorption and emission of light where the new properties are given by electromagnetic near field coupling between the nano-objects included in the material. Concerning phonon transport, a frequency dependence of thermal conductivity can be observed. Plasmons confined in a tapered wave guide slow down producing hot carriers. This hot electron lifetime increases in a hot spot. All these processes occurring at time scales from femtoseconds up to nanoseconds are routinely accessible with ultrafast pump-probe techniques. i.e. heterodyne optical sampling allows to access to the energy transfer and understand the heat propagation into nano-objects themselves. The comprehension of energy transport mechanisms had been initiated by the study of a collection of nano-objects in solution without any coupling between them. We will describe different situations where the energy deposited by a femtosecond flash can be converted into phonons or plasmons traveling respectively at the speed of sound and speed of light in nano-materials. Our ultrafast imaging technique enables to record movies at 20 Tera image per second. Plasmons travelling at speed of light in metallic structures are revealed via the hot electron tail they leave behind them.

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