ULTRAFAST TIME-RESOLVED INVESTIGATIONS OF THERMAL TRANSFER AT THE NANOSCALE

LABORATORY : Institut Lumière Matière

LEVEL : M2
TEAM(S) : FEMTO-NANO

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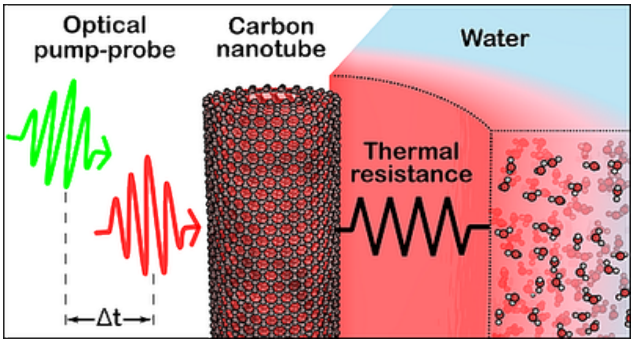
KEYWORD(S) : thermal exchanges / ultrafast spectroscopy / nanoscale

SCIENTIFIC CONTEXT :

Thermal transport at interfaces plays a key role in the heating and cooling dynamics of nanoscale systems. Understanding and controlling heat transfer across interfaces is particularly important for nanomaterials and their applications.



Ultrafast optical spectroscopy on carbon nanotubes in water [1]

This research investigates heat transfer at interfaces both experimentally and theoretically. The thermal response of nano-objects following femtosecond photoexcitation will be studied using **ultrafast optical (pump-probe) spectroscopy**, a non-contact technique that enables the measurement of picosecond-to-nanosecond cooling dynamics. The systems studied will include **Carbon Nanotubes and Graphene Nanoplatelets** dispersed in liquids and embedded in polymers. Their interfaces can be functionalized with molecules to modify heat transfer, while the effects of temperature and pressure will also be explored.

Experimental results will be compared with **Molecular Dynamics simulations** of interface heat transfer, carried out in collaboration with **Politecnico di Torino**. The project will also investigate applications in **photothermal therapy**, in collaboration with a research group in Strasbourg, with the aim of understanding and controlling heat generation and dissipation in nanomaterials under optical excitation.

MISSIONS :

The PhD candidate will conduct **optical ultrafast experiments, analyze data, model results, and interact with scientific partners**.

OUTLOOKS :

The internship can be **extended into a PhD**. Two ANR PhD fundings under review, plus École Doctorale.

BIBLIOGRAPHY :

[1] A. Casto et al., “Experimental optical retrieval of the Thermal Boundary Resistance of carbon nanotubes in water”, Carbon 229, 119445 (2024)

Homepage of the FemtoNanoOptics group

Personal homepage of the project contact

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