NND01: Micro and Nanoscale Heat Transport

Organizers: Jérémie Maire (I2M), Marc Bescond (IM2NP), Gabriel Loget (ISM), Mykola Isaiev (LEMTA), James K Utterback (INSP)

Invited Speakers: To be decided

Sponsors: GDR « NAnoMaterials for Energy applications » (GDR NAME), ANR PROMENADE (ANR-23-CE50-0008)

Content:

While seemingly understood at large scales, thermal transport has garnered an increasing level of research at the micro and nanoscale for ever-smaller device engineering applications and fundamental science. An increased understanding of the behaviour of energy carriers – electrons, phonons and photons – at these scales has improved our control over micro and nanoscale thermal transport, enabling the emergence of innovative functionalities and novel designs and devices based on new phenomena. Spanning decades of temporal and spatial scales, the development of numerical and experimental tools pushing the spatial and temporal limits to ever faster dynamics at shorter length scales have been instrumental in deepening our understanding of these energy carriers and continue to enable further investigations. As thermal transport is a transverse subject, this undertaking is inherently multidisciplinary and benefits from strong interactions, communication and collaborations spanning all the communities involved, from fundamental components with solid-state physics and material science, to methods with nano-optics, metrology and modeling, and to applications in microelectronics, engineering and quantum technologies, to cite a few.

This colloquium aims to bring together leading academic scientists and researchers to exchange and share their experiences and research results on all aspects of Micro and Nanoscale Heat Transport, provide an updated overview of transport mechanisms and heat control levers at these scales, while highlighting their applications. It also provides an interdisciplinary platform to present and discuss the most recent innovations, trends, as well as practical challenges encountered and solutions adopted in this field.

The main topics of the colloquium include (but are not limited to):

1. Fundamentals of Micro- and Nanoscale Heat Transport: Experiments and Modeling
   - Ultrafast heat transfer
   - Heat transport by phonons, electrons and electron/phonon processes
   - Near-field radiative heat transfer
   - Nonequilibrium effects, thermodynamics and devices
2. Experimental Methods and Metrology
   - Nanoscale/microscale thermal metrology
   - Heat transport at interfaces
   - Novel experimental and numerical techniques
   - Multi-scale modeling
3. Emerging materials and structures
   - Heat transport in 2D materials, metamaterials, molecular junctions
   - Thermal transport in nanocomposites, polymers, liquids and amorphous materials
   - Nanomanufacturing and materials design
4. Active thermal functions and applications
   - Thermotronics and thermoplasmonics
   - Thermoelectricity and thermophotovoltaics
   - Bridging scales: from quantum to macroscale heat management
   - Integrating thermal transport with photonics and electrochemistry
   - Radiative cooling and heating

Prospective presenters are kindly encouraged to contribute to and help shape the colloquium through submissions of their research abstracts. High quality research contributions describing original results of conceptual, constructive, empirical, experimental, or theoretical work in these topics are cordially invited for presentation at the conference. Early-career scientists are encouraged to submit their works.
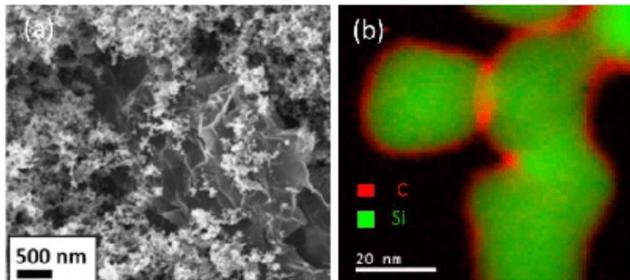

Figure 4. Nanocomposite and nanoparticules for solar energy conversion or photocatalysis and Li ion batteries. Credits: GDR NAME gallery - IRAMIS – LEDNA
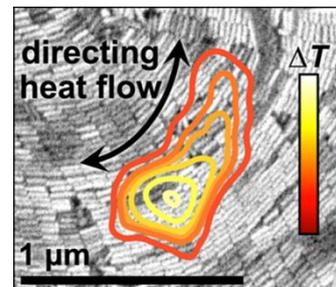

Figure 1. Anisotropic heat flow in self-assembled colloidal nanorods. Credits: INSP.
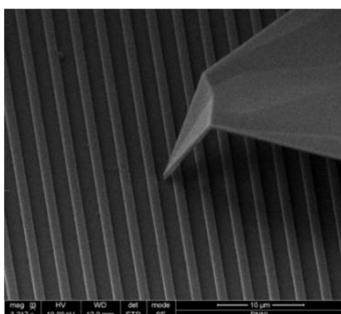

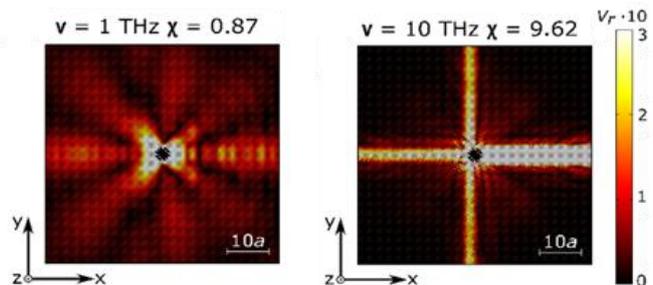*Figure 3. Scanning thermal microscopy. Credits: GDR NAME gallery - CETHIL*

Figure 2. Scattered phonon velocities around a pore in Si. The k-vector of the incident wave is along the x-axis. (APL 124, 142202 (2024)) - LEMTA