



## PhD Position \_ Research Project

# Multiscale study of the thermophysical properties of polymeric materials using Scanning Thermal Microscopy

### SUBJECT

This research project concerns the experimental analysis of the link between microstructure and thermophysical properties of polymeric materials depending on the kinetics of their transformation.

The application to polymers of Scanning Thermal Microscopy (SThM), which is a Scanning Probe Microscopy-based technique [1], involves non-normal conditions of use of the method and requires developments in terms of measurement protocols and analysis to ensure reliability.

Research will concern the implementation and interpretation of experiments that are required for (1) the measurement of the thermal conductivity and (2) the calorimetric measurement, by means of SThM. Model materials will first be used. A thermo-mechanical modelling of the probe-sample system in its surrounding environment will be developed using COMSOL environment. In this modelling the size effects that occur at nanoscales will be taken into account using effective parameters (thermal resistance at the probe-sample nanocontact as an example). These parameters will be identified from scientific literature or estimated in collaboration with the researchers developing thermal modeling at the atomic and molecular scales in the Micro and Nanoscale Heat Transfer group (host group at CETHIL).

The methodology developed will be then applied to study at small scales the thermophysical properties of various polymeric materials, semi-crystalline and / or amorphous, depending on their local microstructure. Microstructure will be characterized using the characterization facilities of the laboratory local platforms (AFM, optical microscopy in polarized light, DSC, Electron Microscopies).

### SUPERVISOR

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Head of the “Micro and Nanoscale Heat Transfer” group (MiNT group) at CETHIL.

### CO-SUPERVISOR

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**HOST GROUP: MiNT Research Group:** <http://cethyl.insa-lyon.fr/index.php?page=micro-et-nanothermique>

The “Micro- and Nanoscale Heat Transfer” (MiNT) group from CETHIL (Centre for Energy and Thermal Sciences of Lyon, UMR CNRS 5008 – INSA Lyon – University Lyon 1) has a broad expertise in the field of nanoscale heat transfer on both theoretical and experimental aspects. It is a renowned member of the scientific community with many important contributions to the fields of near-field thermal radiation, near-field thermophotovoltaics and thermal characterization at nanoscale. Leader of the Large-scale FP7 European project QUANTIHEAT <http://www.quantitheat.eu>.

### Reference

[1] Gomès S., Assy A., and Chapuis P.-O., “**Scanning Thermal Microscopy: a review**”, 2015, Physica Status Solidi (a) 212 pp 477-494.

### PLACE OF WORK

CETHIL: Centre d’Énergétique et de Thermique de Lyon (CETHIL, CNRS UMR 5008), Campus La Doua-LyonTech, 9, rue de la Physique – 69621 VILLEURBANNE (Lyon), France.