UNIVERSITÉ DE REIMS CHAMPAGNE-ARDENNE

GRESPI
Groupe de Recherche En Sciences Pour l'Ingénieur

PhD student position in thermal engineering at Université de Reims Champagne-Ardenne :

Modulated hot wire method for temperature-dependent thermophysical characterization of advanced heat transfer fluids.

Context:
Despite undeniable advantages of the 3omega hot wire method [Cahill 1990, Birge 1987, Dames 2005], commercial thermophysical properties measuring devices have not yet implemented this type of device and only transient techniques are marketed. The 3omega method, due to its high accuracy (<1%) and its low thermal disturbance, is expected to become competitive on the medium term, with transient methods in the field of thermal metrology. Our team recently filed a patent on this technology and built a measuring instrument as part of a technology transfer project with SATT Nord Company. We are currently involved in the thermophysical characterization of nanofluids in the framework of the European project COST CA15119, "Overcoming Barriers to Nanofluids Market Uptake, NANOUPTAKE" (2016-2020). The needs corresponding to this research cannot be satisfied with existing measuring instruments. The main performance criteria are high resolution and reproducibility to differentiate fluids within in the same class of materials and with close thermophysical properties, over a temperature range of 0° C up to 300° C. These experimental needs cannot be met by existing measuring instruments.

Objectives:
The overall objective of the project is to improve the implementation of these techniques, whether at the experimental level or at the modeling level. The specific objectives of the proposed project are:
(i) Deepen the theoretical basis of the hot wire method with modulated 3omega excitation as a modern alternative to the traditional transient hot wire method.
(ii) Developing temperature compensated probes consistent with the patent filed, using an insulated wire, for application to electrically conductive liquids.
(iii) Performing simultaneous and independent measurements of thermal conductivity and volumetric heat capacity on advanced heat transfer fluids: nanofluids, phase change materials (PCMs) and ionic liquids (LIs). Interpreting these results through predictive models of effective thermal conductivity for nanofluids, or in correlation with the molecular structure of LIs. Continuous measurement of two thermophysical parameters during PCM phase transition will be a scientific novelty.
(iv) Demonstrating the relevance of the device for cross-fields and innovative applications not yet exploited by this technology (anemometry, thermophysical properties of gases, phase transition phenomena, thermophoresis, sedimentation, microfluidics, integration with other sensors ("lab on chip").

[Cahill 1990] : D. G. Cahill, Thermal conductivity measurement from 30 to 750 K : the 3w method, Review of Scientific Instument 61 (2) (1990), 802.
[Birge 1987] N.O. Birge and S.R. Nagel, *Rev. Sci. Instrum*. 58, 1464 (1987).
[Dames 2005] C. Dames and G. Chen, *Rev. Sci. Instrum*. 76, 124902 (2005).

Skills sought
The student will have knowledge of thermal science, heat transfer, electronics. Knowledge in signal processing and Python langage is a plus. A good command of the English language for writing reports and scientific articles is necessary, as well as good communication skills in French and/or English.

Remuneration: The net monthly pay will be 1 424.11 € for a period of 36 months (subject to acceptance of funding).

Period: The thesis can start as early as September 2018.

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Candidates will be able to apply on the ADUM site from June 8th following the detailed procedure below:
https://www.adum.fr/as/ed/proposition.pl?site=sts358