Characterization of the thermophysical properties of flame retarted materials and simulation of the fire behavior

Keywords:
Fire behavior, thermal sciences, dimensional analysis, modeling, finite element method, thermophysical measurement

Name of recruiting organization:
University of Lille
Unité Matériaux et Transformations (UMET) - UMR-CNRS 8207 (http://umet.univ-lille1.fr)
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Description of recruiting organization:
The laboratory "Unité Matériaux et Transformations" is a laboratory dedicated to Material science for a large range of applications. The UMET laboratory belongs to a larger consortium, the "Fédération de recherche Michel-Eugène Chevreul", that hosts laboratories related to materials science in Northern France. The UMET is one of the three large members of the consortium, that also includes the Unité de Catalyse et de Chimie du Solide (UCCS) and the Laboratoire de Spectrochimie Infrarouge et Raman (LASIR). Among other tasks, the consortium is in charge of running large scale experimental facilities (NMR, electron diffraction, X-ray diffraction, mass spectroscopy, vibrational spectroscopy...).
The topic of our group “Reaction and resistance to fire (R_2Fire)” is the fire behavior of materials including thermoplastics, thermosets, wood, composites, steel … for large range of applications (aircraft, railways, automotive, E&E, buildings …). The industrial partners are among many others: Airbus, Safran, Dow Corning, Huntsman, BASF, LanXess, Hempel, Sabic, EDF … The group is also involved in European projects (e.g. Phoenix and Deroca on flame retardancy of thermoplastics) and national projects (e.g. ANR Stic and Hypopootam). Different approaches are considered in the R_2Fire group:

- Design and synthesis of novel flame retardants
- Formulation of flame retarded materials and coatings (design, optimization and testing of the formulations)
- Engineering of polymeric materials and coatings (preparation of flame retarded materials and coatings, understanding of the modes of action)
- Design of bench scale test (similitude approach and high throughput testing)
- Functional durability (ageing of flame retarded polymers and coatings, understanding and identification of the interactions)
- Modeling, simulation and optimization (experimental methods for measuring thermophysical parameters and development of numerical codes for simulating the fire behavior of materials)

Description:
The postdoc position is involved in the prestigious ERC Advanced Grant ‘***FireBar-Concept***’ (*MULTI-CONCEPTUAL DESIGN OF FIRE BARRIER: A SYSTEMIC APPROACH ; Proposal N°670747 ; global budget of 2.4 Millions € in 5 years*). The abstract of the project is described below:

The development of science and technology provides the availability of sophisticated products but concurrently, increases the use of combustible materials, in particular organic materials. Those materials are easily flammable and must be flame retarded to make them safer. In case of fire, people must be protected by materials confining and stopping fire. It is one of the goals of the FireBar-Concept project to design materials and assembly of materials exhibiting low flammability, protecting substrates and limiting fire spread.

The objective of FireBar-Concept is to make a fire barrier formed at the right time, at the right location and reacting accordingly against thermal constraint (fire scenario). This fire barrier can be developed in several ways according to the chemical nature of the material and/or of its formulation:

- Heat barrier formed by inherently flame retarded materials (e.g. mineral fibers, ceramic …) and exhibiting low thermal conductivity (note the assembly of those materials can also provide low thermal conductivity controlling porosity and its distribution)
- Evolution of reactive radicals poisoning the flame and forming a protective 'umbrella' avoiding the combustion of the material
- Additives promoting charring of the materials and forming an expanding carbonaceous protective coating or barrier (intumescence)
- Additives forming a physical barrier limiting mass transfer of the degradation products to the flame

The FireBar-Concept project is multidisciplinary and it requires expertise in material science, chemical engineering, chemistry, thermal science and physics. The approach is to make 5 actions linked together by transverse developments (3) according to this scheme: (i) fundamentals of fire barrier, (ii) multi-material and combination of concepts, (iii) modeling and numerical simulation, (iv) design and development of experimental protocols and (v) optimization of the systems.

The objectives of this postdoc deals with the development of methods to characterize the thermal behavior of the flame retarded materials. It will include measurements of thermo-physical parameters (heat capacity, thermal diffusivity, combustion enthalpy etc…) as a function of temperature and taken into account the anisotropy of the material (if any). Thermography will be also considered. It offers therefore the opportunity to work on high challenging project and in an environment of high scientific quality.

Candidate profile

Highly motivated candidates with an academic degree at the PhD level in thermal sciences, materials science, fire engineering are invited to apply for this position. Candidates should have a real interest for experimental science and to be able to rationalize resulting data through a simple modeling approach. The knowledge of English is mandatory. Spoken and written French is an asset.

Contact:

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Job location:

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Work contract: 1 to 2 years contract
Type of contract: CDD
Net salary in Euros: 2000€/month