

Subject Proposal for Exchange Students in Chemistry (Master Level)  
(6 months, at any time of the year)

## **Flame retardancy of polymeric materials**

The high fire hazards posed by polymeric materials both in historical times and to the present days are a consequence of their organic composition. In order to improve their flame retardant (FR) properties, flame retardants may be added to the polymeric matrix. Due to their high efficiency, halogenated flame retardants, in particular the brominated one, have been the additives of choice for many commercial applications. However, the replacement of those additives is of major interest dealing with environmental and human health concerns. Indeed, some brominated flame retardants are already banned via the RoHS directive (2002/95/EC). Moreover, new regulations regarding the disposal and incineration of waste containing these halogenated-based systems tend to cause marketing difficulties for their use. That is the reason why, new halogen free materials have to be developed and this will be the objective of this research project.

The approach followed in the project will consist in the incorporation of additives in the polymer during the process of the material. The candidate will use techniques available in the lab including microextruder, mixer, twin-screw extruder and injection-molding to make various formulations. The samples will be then evaluated by specific fire testing (cone calorimetry, UL-94, microcalorimetry, GWFI and LOI). One of the main challenge of this internship will be to select FR additives coming from renewable resources and to get acceptable properties without modifying the others (e.g. mechanical properties). The characterization of the samples will be done using appropriate techniques (SEM for the dispersion of the additives in the polymer, DSC for the crystallinity, NMR and FTIR). The mechanism of action will be investigated using novel protocols developed in our laboratory based on rheology, on calorimetry and on measurement of the thermophysical properties of the materials. It is expected for the student to get a multidisciplinary training in a growing area of material science and formulation on an exciting applied topic.

**Key Words:** Flame retardancy, Polymer, Extrusion, Formulation

**Profile of candidates:**

The candidate should preferably have some knowledge of polymer materials (processing and characterization of polymeric materials).

**Gratification:** 450€/month

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