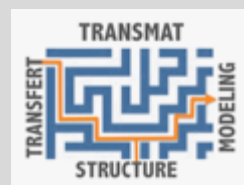




15 – 17th September 2014 in Montpellier, France

## The 3 Days of the TRANSMAT team

« Sustainable Food Packaging Research »



### Free entry

(please send a simple email to [patricia.havelange@univ-montp2.fr](mailto:patricia.havelange@univ-montp2.fr) to let us know about your participation)

Detailed content and practical information are below-provided

### Monday 15th September

**14:00 - 17:00 – PhD Defense of Marie-Alix BERTHET on « Sustainable biocomposites for food packaging issued from food industry by-products : Structure-properties relationships »**

Jury's members : N. DEMARQUETTE, S. HOPPÉ, M. REIS, A. DUFRESNE, X. ROUAU, N. GONTARD, H. ANGELLIER

Montpellier SupAgro – Amphi 206 (cœur d'école)

**From 17:00 – Friendly drink and congratulations to Marie-Alix**

Montpellier SupAgro – Place to be confirmed

### Tuesday 16th September

**9:30 - 12:30 – Workshop on « Turning Biomass into Materials and Energy, R&D challenges »**

Speakers : Pr. M. REIS (Univ. Nova de Lisboa, Portugal), Dr. X. ROUAU (INRA, Montpellier), Dr. J. BRAS (Pagora, Grenoble), Pr. F. DOGHIERI (Univ. Bologna, Italy), Dr. V. COMA (Univ. Bordeaux), Pr. J. LEGRAND (Univ. Nantes), M. MAURICIO (DTU Denmark), Dr. C. GUILLAUME (Univ. Montpellier)

Montpellier SupAgro – Room 108 (cœur d'école)

**12:30 – 14:00 – Lunch** (5 euros cash, to be paid locally)

Montpellier SupAgro - Hall d'honneur (cœur d'école)

**14:00 – 17:00 – PhD defense of Caroline WOLF on « Multi-scale Modelling of Structure and Mass Transfer Relationships in Nano- and Micro- Composites for Food Packaging »**

Jury's members : V. COMA, J. LEGRAND, J. BRAS, F. DOGHIERI, N. GONTARD, V. GUILLARD

Montpellier SupAgro – Amphi 206 (cœur d'école)

**From 17:00 – Friendly drink and congratulations to Caroline**

Montpellier SupAgro – Place to be confirmed

### Wednesday 17th September

**9:30 - 12:30 – PhD Defense of Brais MARTINEZ-LOPEZ on « Development of new characterization methodologies & modelling of transport properties on plastic materials: application to homologous series of tracers. »**

Jury's members : F. DOGHIERI, F. POCAS, C. FAUR, C. JOLY, M. MAURICIO, S. PEYRON, N. GONTARD

Place to be confirmed

**13 :00 – 15 :00 Friendly drink and congratulations to Brais**

Place to be confirmed

**From 14 :00 - Visit of IATE equipments and pilot-scale facilities**

Montpellier SupAgro – Building 37



## PhD thesis of Marie-Alix Berthet

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« Sustainable biocomposites for food packaging issued from food industry by-products : Structure-properties relationships »

### Jury's members

Pr. Nicole DEMARQUETTE, École de Technologie Supérieure/Université du Québec - Rapporteur  
Dr. Sandrine HOPPÉ, CNRS/LRGP/ENSIC - Rapporteur  
Pr. Maria REIS, FCT Univ. Nova de Lisboa, Portugal - Reviewer  
Pr. Alain DUFRESNE, Grenoble INP – PAGORA - Reviewer  
Dr. Xavier ROUAU, INRA, IATE Montpellier - Reviewer  
Dr. Hélène ANGELLIER-COUSSY, Université de Montpellier 2 –Co-supervisor  
Pr. Nathalie GONTARD, INRA, IATE Montpellier –Supervisor

### Abstract

The objective of this study is to eco-design new biosourced and biodegradable composite materials for the packaging of fresh products, using solely derivatives from agro-industry by-products, i.e. a bacterial polyester (PHBV) and lignocellulosic fibres (wheat straw fibres in particular). A special interest has been given to better understand the structure-functional properties relationships within such materials.

For that purpose, this work has been divided in three parts. -1-Exploration of the respective impact of botanical origin of lignocellulosic fibres, fibres size and content, on composites process-ability, structure, and functional properties (mechanical and barrier properties). -2- Better understanding of structure/properties relationships within PHBV/wheat straw fibres via the study of the impact of two key parameters, i.e. fibre polydispersity and moisture content at the moment of material shaping. -3-Improving mechanical performance of the composite, via two strategies, i.e. the hydrophobisation of the fibres through a thermal treatment (torrefaction) and the modification of the matrix by introducing plasticizing substances.

It has been demonstrated that introduction of an increasing content of wheat straw fibres had a negative impact on mechanical properties of PHBV, with an accent on material's fragility, while its water vapor permeability increased, which can be interesting for packaging of respiring products. Those effects have been related to the presence of defects induced by the incorporation of fibres, to a degradation of the polymer matrix, emphasised by the presence of fibres during shaping steps, and most of all, by a poor interfacial fibre/matrix adhesion. It has been demonstrated that PHBV mechanical properties could be preserved, even improved, by reducing fibres size, improving interfacial fibre/matrix adhesion by fibres torrefaction, and/or plasticization of the matrix.

## **Workshop « Turning Biomass into Materials and Energy, R&D challenges »**

*10 min of presentation from each speaker followed by general discussion with all participants*



**Pr. Maria Reis - FCT Univ. Nova de Lisboa - Caparica, Portugal**

**« Production of Biopolymers by mixed cultures & renewable feedstocks: Bottlenecks & challenges »**



**Dr. Xavier Rouau - INRA Montpellier, France**

**« Direct use of solid biomass in internal combustion engines »**



**Dr. Julien Bras - Pagora Grenoble INP, France**

**« Use of nanocellulose for active packaging »**



**Pr. Jack Legrand - Université de Nantes, France**

**« Micro-algae as a resource for energy and materials production»**



**Pr. Ferruccio Doghieri - DICAM, University of Bologna, Italy**

**« Graphene based coatings for packaging applications»**



**Dr. Véronique Coma - Université de Bordeaux, France**

**« Bio-polymers films with antimicrobial and antioxidant properties»**



**Dr. Carole Guillaume - Université Montpellier 2, France**

**« Bio-based sensing film for monitoring food shelf life »**



**Dr. Fatima Pocas - Universidad de Porto, Portugal**

**« Consumer exposure to packaging materials components»**



**Dr. Miguel Mauricio-Iglesias – DTU, Denmark**

**« Managing close partnership with industry and R&D institute : Biopro, a Danish project as a framework for company-university collaboration»**



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**PhD thesis of Caroline Wolf**

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**« Multi-scale Modelling of Structure and Mass Transfer Relationships  
in Nano- and Micro- Composites for Food Packaging »**

**Jury's members**

Dr. Véronique COMA, Université de Bordeaux - Rapporteur  
Pr. Jack LEGRAND, Université de Nantes - Rapporteur  
Dr. Julien BRAS, Grenoble INP-Pagora - Reviewer  
Pr. Ferruccio DOGHERI, Université de Bologne, Italy - Reviewer  
Pr. Nathalie GONTARD, INRA Montpellier - Reviewer  
Dr. Valérie GUILLARD, Université de Montpellier –Supervisor

**Abstract**

Despite the global growing interest in the food packaging field for the design of tailored composite structures with controlled mass transfer properties, the understanding of the modulation of the mass transfer properties with the incorporation of particles in polymer still remains very complex. In order to throw light on this scientific problem, the thesis work was focused on the following parts:

- providing a better understanding of mass transfer in composites. In this purpose an analysis of all experimental gas and vapour permeability data available in the literature has been carried out in nano- and micro- composites and a comparison of these data with predictions from tortuosity models based on few geometrical inputs has been achieved;
- performing a detailed study of water vapour mass transfer in composites (wheat straw fibres/bio-polyester). These data were compared with the prediction of bi-phasic analytical models coming from other disciplinary fields. This part of the work has highlighted the lack of comprehensive and complete models for the prediction of permeability in composite with permeable particles;
- developing of an innovative multi-scale approach for the prediction of mass transfer in biphasic composites considering both the particle and the polymer matrix properties with realistic 2D geometry of the composite structures has been proposed. For the sake of reaching a satisfactory validation level of the model, some experimental improvements are still needed to increase the accuracy of input parameters such as diffusivity of the particles.

This new modelling approach open the way for the creation of a reverse-engineering toolbox for the design of tailor made composites structures, tightly adjusted to barrier properties requirements of the packed food.



## PhD thesis of Brais Martinez Lopez

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«Development of new characterization methodologies and modelling of transport properties on plastic materials: application to homologous series of tracers.»

### Jury's members

Pr. Ferruccio DOGHIERI, Université de Bologne, Italy - Rapporteur  
Dr. Fátima POCAS, Universidad de Porto, Portugal - Rapporteur  
Pr. Catherine FAUR, IEM – Reviewer  
Dr. Catherine JOLY, Univ. C Bernard, Lyon - Reviewer  
Dr. Miguel MAURICIO-IGLESIAS, Technical University of Denmark - Reviewer  
Dr. Stéphane PEYRON, Université de Montpellier – Co-supervisor  
Pr. Nathalie GONTARD, INRA Montpellier- Supervisor

### Abstract

Food contact materials must comply with the inertia criteria defined by European regulation, which establishes migration limits for substances that may be transferred into food. Traditionally, migration levels were determined experimentally by performing money and time-consuming migration tests. Recently, modelling tools have been approved to predict migration levels of additives from plastics. However, these models need of certain parameters: the diffusion coefficient or diffusivity, the mass transfer coefficient and the partition coefficient. These coefficients, particularly diffusivity, may be determined experimentally or by predictive modelling.

Raman micro-spectroscopy was used to develop a methodology for the characterisation of diffusivity, using amorphous polystyrene as model polymeric matrix. This methodology was applied to two families (homologous series) of molecules presenting the benzenic ring as fundamental unit, with the goal of establishing relationships between diffusivity in the polymeric matrix and geometrical characteristics of the molecules (volume, length, compressibility), describing molecular mobility in function of their hindrance.

This method has also been adapted to LLDPE, with the goal of establishing the operating conditions allowing to simultaneously determine both diffusivity and mass transfer coefficient.

This work has also allowed to lay the foundations of a diffusivity prediction model, based on geometrical and dynamical characteristics of molecules, without the need of a huge computing power compared to other models present in literature. As well, this work permitted to study the sensitivity of the mathematical models regarding simultaneous regression of several variables used in the description of mass transfer.

## How to get to Montpellier SupAgro

2, place Pierre Viala - 34060 Montpellier

<http://www.supagro.fr/web/>



### 1. By plane

From Montpellier – Fréjorgues airport, take the schedule to the bus station (gare routière).  
For more information, Montpellier airport:

Tel.: 04 67 20 85 00 or <http://www.montpellier.aeroport.fr/>

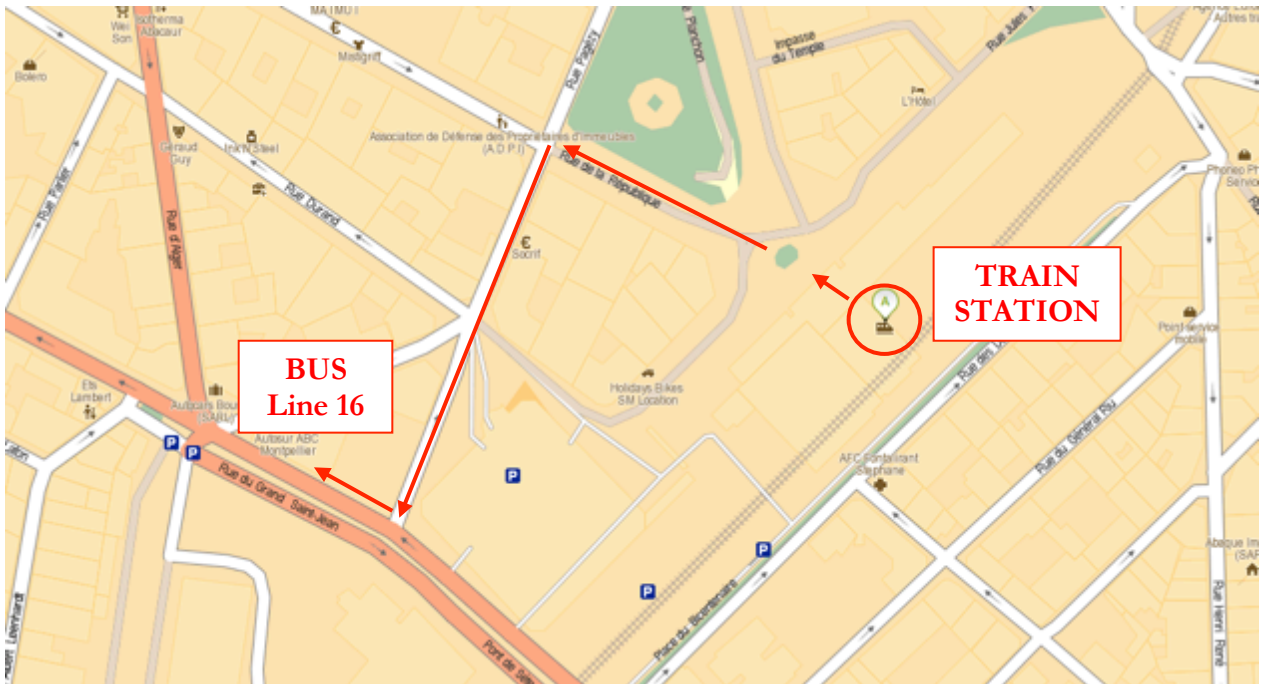
At any time, if you need a taxi, call:

- Taxi Bleu du Midi : +33 (0)4 67 03 20 00 or +33 (0)4 67 10 00 00, <http://www.taxibleudumidi.fr/>
- ATH Taxi : +33 (0)4 30 57 10 07 <http://www.athtaxi.fr/>

## 2. By bus from the station or the city center

By bus (from 6 am to 9 pm), from the railway station SNCF or the city center (place de la Comédie), take the line 16: towards "Euromédecine", get off at "Pierre Viala" station. You can buy a ticket directly in the bus.

When you get off the train station, cross the place and go straight on at the street "Rue de la République" and turn left at the "Rue Pagezy". Go straight on until the end of the street and turn right. Take the bus line 16.



## 3. By road

From the motorway:

- Take "Montpellier Sud" exit
- At the roundabout follow "Mosson"
- Continue 4 kilometers (rue de l'Abrivado then Avenue des Prés d'Arènes then Avenue de la Liberté) towards « Mosson » direction.
- Turn right direction "Hôpitaux Facultés"
- At the shopping center "Géant", continue straight through the tunnel
- Turn right at the 4<sup>th</sup> traffic light after the tunnel, then follow signs SupAgro - INRA (~1 km)



Montpellier  
SupAgro

