Proposal research subject:

Titre : *Structure-properties relationships on multiphase polymer blends.*

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Multiphase polymer systems are extremely important to gain some synergic properties. It is therefore necessary to carry out fundamental research to create the conditions for a better optimization of both rheological and morphological behaviors. These objectives cannot be achieved without a close relation between polymer structure and properties relationships. The main objective of this thesis is to investigate effect of flow on morphological/structure behaviors with multiphase polymeric systems with more than two phases. Effect of fillers will be also investigated.

- The first part of this work will be generic and concerns in particular the optimization of the choice of materials and/or their copolymers constituting blends or multilayers. Some bio based fillers could be also introducing for compatibilization and/or the physical properties. We will specifically explore the consequences of the degree of compatibility of the polymers and the effect of these fillers on the compatibilization and the induced morphology. One part of the study will be devoted to understand the influence of functionalization, molar mass, and polydispersity of the chosen polymers. Through model rheological and melt dielectric experiments, we will attempt to understand and tune the generated interfaces/interphase, in particular adhesion. These experiments will be supported by rheological modeling of the diffusion and/or reaction.
- The second part of the subject will be more specific and will highlight the importance of flow effects on the morphology and the mechanisms related to the appearance and development of instabilities. Well controlled properties are expected to result from the improvement of interlayer continuity and crystallization thanks of a better understanding of layers' homogeneity, phases distributions and architectures. The originality/focus of the project is to gain a true understanding of the induced interfacial phenomena especially in presence of some interfacial chemical reaction between the constituents with or without the nano fillers, which is rarely present in the literature. As for the interphase created, it will be characterized in detail by XPS, AFM and EDX spectroscopies. The effect of flow on the crystalline amount and morphology of the obtained layers will be investigated by SAXS/WAXS and other techniques.

Authors' quoted references in the field:

[1] **H. Zhang, K. Lamnawar, A. Maazouz 2018.** Understanding of Transient Rheology in Step Shear and Its Implication To Explore Nonlinear Relaxation Dynamics of Interphase in Compatible Polymer Multi-microlayered Systems. **Ind. Eng. Chem. Res.,** 2018, *57* (23), pp 8093–8104

[2] **B. Lu, K. Lamnawar, A. Maazouz 2017.** Rheological and dynamic insights into an in situ reactive interphase with graft copolymers in multilayered polymer systems. **Soft Matter,** 2017, 13, 2523-2535.

[3] **Walha F., Lamnawar K., Maazouz A., and Jaziri M. 2017.** Preparation and characterization of Bio-sourced Blends based on Poly (lactic acid) and Polyamide 11: Structure-properties relationships and Enhancement of film blowing processability. **Advances in Polymer Technology**, 12 JUL 2017, DOI: 10.1002/adv.21864

[4] **Khemakhem M., Lamnawar K., Maazouz A., and Jaziri M. 2017** Effect of core–shell acrylate rubber particles on the thermomechanical and physical properties of biocomposites from polylactic acid and olive solid waste "**Polymer engineering & science** 9 JUN 2017, DOI: 10.1002/pen.24642

[5] **Al-Itry R, Lamnawar K., Maazouz A, Billon N., and Combeaud C. 2015.** Effect of the simultaneous biaxial stretching on the structural and mechanical properties of PLA, PBAT and their blends at rubbery state. **European Polymer Journal, 68:288. doi:10.1016/j.eurpolymj.2015.05.001**

[6] **Al-Itry R, Lamnawar K., Maazouz A. 2015.** Biopolymer Blends Based on Poly (lactic acid): Shear and Elongation Rheology/Structure/Blowing Process Relationships**. Polymers, 7(939-962) 2015. Doi: 10.3390/polym7050939**

[7] **Al-Itry R, Lamnawar K. Maazouz 2014.** Rheological, morphological, and interfacial properties of compatibilized PLA/PBAT blends **Rheologica acta** 53, 7, 501-517 DOI: 10.1007/s00397-014-0774-2.

Short CV of the principal supervisor:

Prof._A. Maazouz was born in 1957. He is a Professor of polymer engineering and science in the Laboratory of Polymer Materials Engineering (IMP) at National Institute of Applied Science at Lyon (INSA de Lyon), France. Currently He is co-Chairman of "Polymer Structure and Rheology" center in the lab of IMP-UMR CNRS 5223. He is a candidate to organize the PPS 2016 in Lyon, France. Prof. Maazouz's research interests cover wide domains, including i) Structure/processing/property relationships of polymers; ii) Rheology and process engineering of polymer materials, biopolymers and their composites; iii) Interfacial phenomena in the polymer and composites processing; iv) Monitoring and optimization of polymer processes (extrusion, co-extrusion, roto-molding, resin transfer molding, etc.). Contributions on these domains lead him to have 100 peer-reviewed scientific articles, 5 patents, 2 book chapters and more than 90 oral and poster communications where he has on numerous occasions been an invited speaker and a chair-man of conferences. He was recently honored by French government by the "Palm academic medal": Palmes académiques. Prof. Maazouz is also Reviewer of several scientific journals: *Polymer*, *International Material Forming*, *Rheologica Acta*, *Polymer Engineering & Science*.

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