

|| SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Multifunctional Polymer Nanocomposites for Sustainable Development

Polymer-based (nano)composites reinforced with high-performing nanomaterials or fibres are attractive for highly-demanding sectors, such as automotive, aerospace or construction due to their light weight and excellent properties. However, the vast majority of polymer matrices and fibres used in their manufacturing are non-renewable, fossil-derived materials that require high amounts of energy for their production. Additionally, the lack of re-processability and difficulty for repairing and recycling significantly increases the cost and causes grave environmental concerns.

The proposed PhD project will focus on the use of novel bio-based/recycled polymers and high-performing fillers originating from eco-friendly technologies for the production of multifunctional nanocomposites. Polymers extracted from biomass and polymers produced directly from microorganisms will be targeted. The range of sustainable fillers will include combinations of natural fibres with nanocarbons and nanocellulose. A number of advanced strategies will be explored for the production of the novel bio-composites with the main focus being the sustainability of the process, the minimization of the use of solvents, the scalability and the maintenance of the bio-based character of the project. The group has extensive experience in the production and characterization of bio-based polymers and composites [1-3]. Interdisciplinary research will be delivered in order to tackle the great plastics problem and generate multifunctional materials with key application targets across different high-tech industries (ie. stretchable bioelectronics, packaging applications and structural/automotive components).

[1] Papageorgiou *et al.* European Polymer Journal 2016 83, pp. 202-229

[2] Papadopoulos *et al.* Polymers 2018 10 (9), pp. 937

[3] Pouloupoulou *et al.* Macromolecular Materials and Engineering 2018 303 (8) 1800153

2. Project Scope

- To design and deliver high-performing nanocomposites based the combination of bio-based polymers with sustainable reinforcements.
- To carry out advanced, application-driven characterization with state-of-the-art techniques at QMUL and Nanoforce facilities in order to study and understand the structure and the functionalities of the produced bio-based nanocomposites.

- To correlate experimental observations with theory and apply or develop models that are able to predict the behavior of the nanocomposites.

3. Desired Skills from the Student

Strong interest in polymers, composites and polymer engineering.

Background on materials science, physics, chemistry and physical chemistry (ideally a masters level graduate).

Excellent experimental skills.

Excellent theoretical understanding.

Good spoken and written English.

Attention to detail.

4. Supervisory Team

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