Design of the cellulose derivatives based thermoplastic composites for circular economy and sustainable environment

Summary

Sustainable thermoplastic polymers are developed and investigated to partly or fully replace non- renewable-resources-based materials for melt processing technologies. Cellulose appears to be a nearly unlimited renewable resource for polymeric materials. Discovery of dissolution processes of cellulose in ionic liquids opens several new routes for functionalization. Thermoplastic cellulose derivatives can be prepared without use of plasticizers, by attaching long-chain ester branches to the macromolecule of cellulose. Based on circular economy and sustainable environment principles the functionalized cellulose based thermoplastic composite materials are considered as viable solution for commodity products. The research challenge is to design the cellulose thermoplastic composites to enhance the mechanical properties of the novel thermoplastic materials. A laboratory line for pilot production of the novel thermoplastic materials will be started. Producing and processing parameters of the novel materials will be clarified for further commodity applications.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Jaan Kers Dr. Heikko Kallakas
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

The Ph.D. candidate has the following tasks as an active member of the thematic research group:

- Composing comprehensive literature survey of the state of the art in the field of cellulose derivatives and enhancement of physical, mechanical and technological properties of cellulose composites. Selection of the suitable additives for improvement of aforementioned properties.
- Active participation in design of cellulose derivative thermoplastic composite material also consulting research collaborates abroad (Aalto University, University of Helsinki, etc.)
- Participation in developing the machinery and pilot line for producing the cellulose derivatives for technological trials.
- Characterization of the cellulose derivatives based thermoplastic composites (DSC, rheology, Vicat softening temp and HDT, MFI) finding optimal relations between chemical, physical and technological properties of the novel materials.
- Design of experiment for material recipes for technological trials and testing of the physical and mechanical properties of the composites.
- Participation in elaboration of methodology for environmental impact evaluation and LCA.
- Publishing of the results as journal articles and conference presentations.

Qualifications:

MSc in organic chemistry /polymer chemistry/ wood chemistry/ cellulose chemistry and technology/ pulp and paper technology

The applicants should fulfil the following requirements:

The candidate should be familiar with methods, procedures and safety of laboratory of polymer chemistry and wood, which allows to work independently. Previous experience in cellulose chemistry and polymer technology would be highly appreciated. Previous experience in the most relevant characterization methods (DSC, rheology, Vicat softening temp and HDT, MFI, compounding, injection molding, compression moulding, mechanical testing, creep tests, artificial weathering, evaluation of environmental impacts, LCA) is also expected.

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