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Bioregs Doctoral programme

Research plan

Development and preparation of novel functionalized film materials for sustainable food packaging

The food packaging industry today strongly relies on oil-based packaging materials and is an important operator among the users of plastic materials. Since there is a growing pressure to bring this industry to more sustainable direction novel environmentally friendly packaging materials are needed. Novel functionalized hemicellulose-based film materials can answer to these needs. Being bio-based materials they are environmentally sustainable and free of harmful chemicals. Suitable antimicrobial properties can be introduced by using natural compounds of plant origin. The processing of these novel materials can be carried out in green recyclable ionic liquids (ILs) without using environmentally harmful organic solvents.

The first aim of the research is to develop a method for selective extraction of hemicelluloses from the lignocellulosic biomass using suitable ILs. Suitable ILs will be screened to find selective and preferable recyclable new candidates. After the extraction of hemicelluloses, and further chemical cooking and bleaching, the remaining biomass can be utilized in other purposes.

The second aim is to study and engineer the physical and chemical properties of the hemicellulosic materials obtained in order to develop film materials that could be used in food packaging. Modification of the hemicellulosic material will be carried out in suitable ILs. First target of the modification reactions is to improve the moisture barrier properties of the hemicellulosic material. Secondary target of the modification is to improve the antimicrobial properties of the material. In addition to this, the effect of bio-based additives on the water vapor permeability and mechanical properties of the material will be studied.

The novel approach for simultaneous extraction and modification (reactive extraction) of hemicellulose using ILs will be researched. The work includes a vast analytical part as the extracted and chemically modified hemicelluloses as well as films thereof need to be thoroughly characterized.

Hemicelluloses used in the research will be both of wood and agricultural origin from domestic sources. The sustainability and biodegradability of the developed materials will be borne in mind during the whole research project. The recyclability and cost of the ILs used will be taken into consideration in order to develop an extraction process that could be adopted into a large scale.