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Towards the preparation of fully biobased membranes

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Abstract

The transition towards a sustainable economy, imperative for facing the current global problems, passes through the replacement of traditional petroleum based and hazardous materials with new chemicals which can be obtained from renewable, recyclable and biodegradable resources. The use of new sustainable materials, such as biopolymers and green solvents, meets the requirements of the Process Intensification Strategy [1] and Green Chemistry Design [2-3]. Membrane technology is widely recognized as one of the Best Available Technologies in the field of separation and filtration also thanks to their low environmental impact. However, the preparation of polymeric membranes is, most of the times, still based on the use of toxic solvents and fossil derived polymers.

Aim of this work, was to fabricate fully biobased sustainable membranes employing poly(hydroxybutyrate-co-hydroxyvalerate) (PHBhv) as a biopolymer and Cyrene™ as a green solvent [4]. Membranes have been prepared by coupling induced phase separation (NIPS) technique with evaporation (EIPS) technique. Polyvinylpyrrolidone (PVP K17 and K30), poly (ethylene glycol) (PEG) at different molecular weight (200 and 600 g/mol) and epoxidized broccoli oil (EBO), a valorized co-product from the synthesis of a food active ingredient, have been investigated as additives for tuning membrane properties. Membranes have been prepared by varying different parameters including polymer concentration, additives concentration and evaporation time before coagulation. Obtained membranes were characterized in term of morphology, pore size, porosity, contact angle, mechanical properties, FT-IR spectroscopy, water permeability and biodegradability. Membranes with different morphologies and pore sizes have been, thus obtained, on the basis of the selected operating conditions and dope solution composition. PHBhv membranes, with a dense structure, have been finally tested in pervaporation for the separation of the azeotropic mixture methanol/methyl-*tert*-butyl-ether.

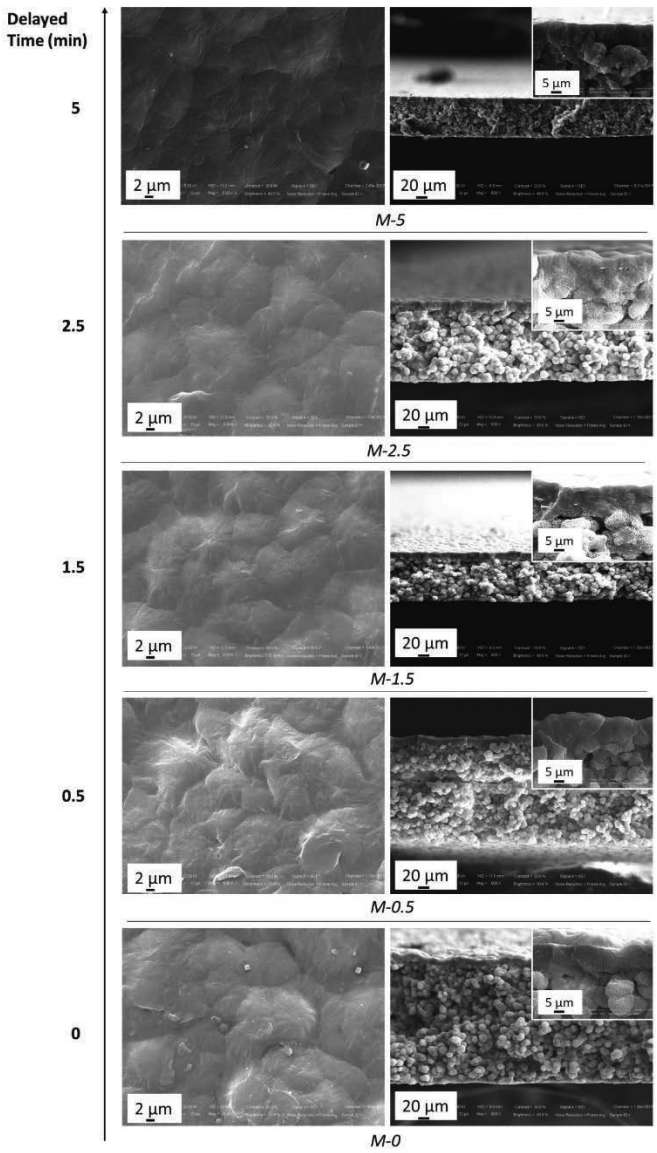

Figure 1. SEM pictures (surface and cross-section) of PHBhv membranes prepared at different evaporation times

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