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FUNCTIONALIZATION OF NANOCELLULOSIC STRUCTURED MATERIALS IN SUPERCRITICAL CARBON DIOXIDE FOR ANTIMICROBIAL WOUND DRESSINGS DESIGN

Clémentine Darpentigny[1,2,3*], Julien Bras[1], Bruno Jean[2], Guillaume Nonglaton[3]
[1]Laboratory of Pulp and Paper Science and Graphic Arts – LGP2 UMR 5518 / CNRS – Grenoble INP – Agefpi, France
[2] Centre de Recherches sur les Macromolécules Végétales (CERMAV-CNRS), BP 53, F-38041 Grenoble Cedex 9, France
[3] CEA, LETI, MINATEC Campus, F-38054 Grenoble, France
*clementine.darpentigny@cea.fr, guillaume.nonglaton@cea.fr

Nanocellulose particles are a class of very promising bio-based materials. They are lightweight, resistant, nanoscale and non-toxic particles. In the biomedical field, their relatively low cost, low toxicity and biocompatibility have made them very attractive.1 Chemical functionalization is necessary to impart new properties to nanocellulose such as antimicrobial properties. Available modification strategies with cellulose are varied and most treatments are performed in aqueous or alcoholic media.2 Supercritical carbon dioxide (SC-CO2) could be used as a non-toxic, ecofriendly solvent to expand the range of nanocellulose green functionalization with apolar molecules.

In this study, nanocellulose membranes were prepared from vacuum filtration of solvent and highly porous aerogels with high specific surface area were obtained from supercritical drying. The use of silanes is a convenient approach for the functionalization of hydroxylated surfaces. Here, the graftings of an amino silane, a mercapto silane and a silane containing an activated ester function using SC-CO2 as a solvent were studied. A silicon wafer was used as a model surface to study the silanization in SC-CO2 before transferring the technology to the nanocellulose membranes. The mechanical integrity of the nanocellulose materials upon exposure to SC-CO2 was then investigated. Although fragile and lightweight, those structures were not affected by the temperature and pressure conditions (50°C, 120 bars). The grafting efficiency was characterized by X-ray photoelectron spectroscopy (XPS), 13C-NMR analysis and fluorescence coupling.

We have proved that the silanization of nanocellulose was possible in supercritical fluid at relatively low temperature, pressure and reaction times. Various strategies are considered to impart antimicrobial activity to the nanocellulose structures. Indeed, many essential oils are soluble in SC-CO2 and could react with the activated ester or thiol groups of the grafted silane thanks to an abundance of alcenes and alcohols groups present in many essential oils molecules.

References

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