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Functionalization of cellulose nanocrystals by non thermal plasma in liquid-gas media

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PURPOSE OF THE ABSTRACT
The emergence of new resources such as biosourced nanocelluloses as substitutes to fossil fuel has led to the development of green and sustainable technologies for the valorization of bio-based materials. The extraction of cellulose nanofibrils and cellulose nanocrystals (CNC) is leading to a worldwide research to use these nanomaterials in product applications due to their high strength, relative low cost, high surface area and unique photonic characteristics. In this context, the use of non-thermal plasma has a very promising potential because of its proven efficiency in the modification of cellulosic materials. The plasma treatment of cellulose nanocrystals dispersed in water was carried out in a dielectric barrier discharge reactor for several minutes under air. The modification of the cellulose nanocrystals was made via the gas/liquid interface, that lead to the formation of highly reactive oxygen and nitrogen species (RONS). The formation of these species led to the formation of an acid, the pH of the solutions dropping considerably with the treatment time, reaching 1.5 after 20 minutes. Subsequent to plasma treatment, samples were freeze-dried and analyzed by FT-IR, XPS and elementary analysis.
The surface of the cellulose nanocrystals was oxidized and the presence of nitrogen was detected, indicating the successful modification of the cellulose nanocrystals by an environmental friendly method. In parallel, studies were performed on glucose and cellobiose.
The process is suitable for adding new functions to cellulose nanocrystals, adjusting their properties for further applications. Due to all of the advantages that cold plasma has to offer, there is no doubt that this process will one day challenge the traditional chemical methods used for the modification of the cellulose nanocrystals.

FIGURES

FIGURE 1

Figure 1

Freeze-dried cellulose nanocrystals before (left) and after plasma treatment

FIGURE 2

KEYWORDS

non thermal plasma in liquid | liquid gas interface | cellulose nanocrystals

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