



1 Article

Surface Characterization of Powdered Cellulose Activated by Potassium Hydroxide in Dry Condition

4 Through Ball Milling

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13 Supplementary Materials

14 CP-MAS ¹³C-NMR analysis of powdered cellulose (Figure S1), powdered cellulose co-

- 15 milled with maleic anhydride (Figure S2) and powdered cellulose co-milled with maleic
- 16 anhydride and potassium hydroxide (Figure S3), in completely dry condition and at room
- 17 temperature.
- 18 The spectra of all samples display typical signals from cellulose that are assigned as follows:
- 19 C1 (106.63 ppm), C4 (90.66 ppm), C2/C3/C5 (83.83 and 77.08 ppm) and C6 (64.23 ppm)
- 20 peaks belong to carbons of the glucopyranose rings in the crystalline regions. The spectrum
- 21 of powdered cellulose sample is presented in Figure S1. After maleation in presence of
- 22 potassium hydroxide (Figure S3), the characteristic signals of the grafted moieties emerged
- 23 at 171.31 to 174.73, 139.30 to 142.02 and 24.30 ppm, corresponding to the carbons of the
- 24 carbonyl (and carbonyl conjugated to ester bond) and vinyl-like structure, respectively. In
- 25 contrast, carbonyl group signals emerged at 170.91 to 174.84 ppm, while no obvious signal
- appeared at 24 ppm of the mixture of cellulose powder and maleic anhydride without any
- 27 base (Figure S2). The spectra of all samples also suggest that the crystalline structure of
- 28 powdered cellulose is not altered significantly.



- 31 Figure S1: CP-MAS ¹³C-NMR spectra of powdered cellulose prepared by ball milling of
- 32 bleached softwood pulp residues.







- 35 maleic anhydride through ball milling.
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38 Figure S3: CP-MAS ¹³C-NMR spectra of powdered cellulose prepared by co-milling with

- 39 maleic anhydride and potassium hydroxide through ball milling.
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- 42 **Figure S4:** CP-MAS ¹³C-NMR spectra (stacked plot) of powdered cellulose (black or bottom
- 43 line), powdered cellulose co-milled with maleic anhydride (red or middle line) and powdered
- 44 cellulose co-milled with maleic anhydride and potassium hydroxide (blue or upper line).
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47 **Figure S5:** CP-MAS ¹³C-NMR spectra (stacked plot, high resolution) of powdered cellulose

48 (black or bottom line), powdered cellulose co-milled with maleic anhydride (red or middle

- 49 line) and powdered cellulose co-milled with maleic anhydride and potassium hydroxide (blue
- 50 or upper line).
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Figure S6: CP-MAS ¹³C-NMR spectra (stacked plot, high resolution) of powdered cellulose
(black or bottom line), powdered cellulose co-milled with maleic anhydride (red or middle
line) and powdered cellulose co-milled with maleic anhydride and potassium hydroxide (blue
or upper line).

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