

Support Information

High solids fibrillation of cellulosic fibers with and without pretreatments through planetary ball milling

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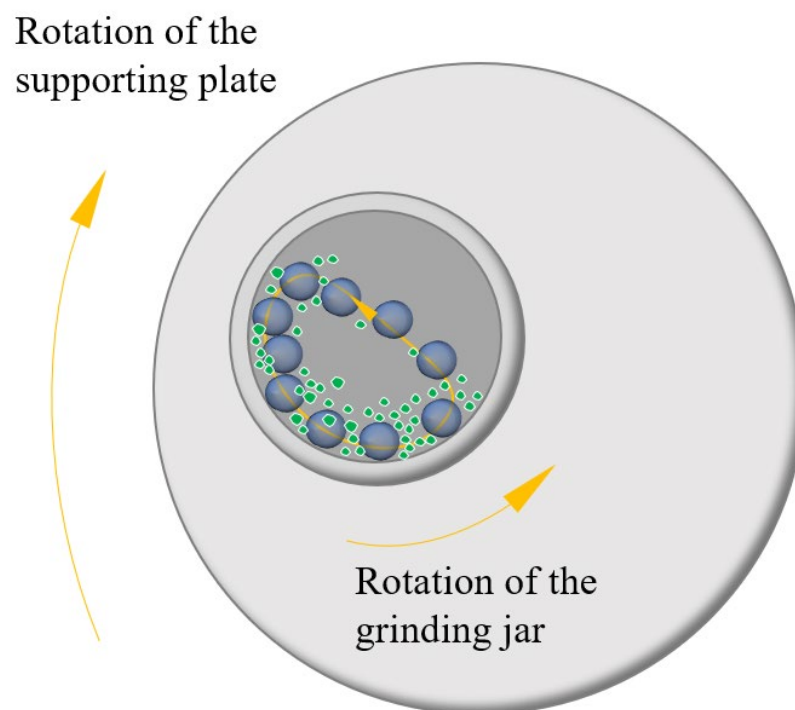


Fig. S1 Operation diagram of ball mill

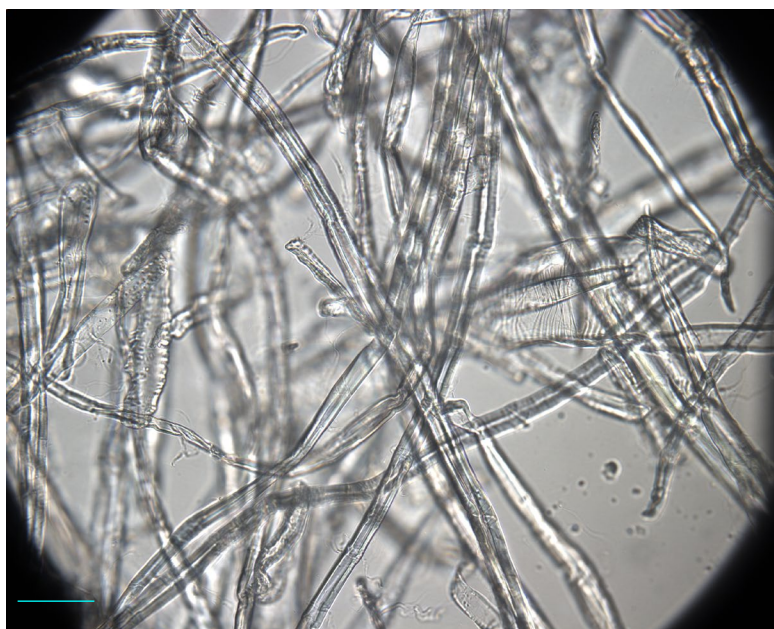


Fig. S2 A LM image of the original BKHP fibers. Scale = 50 μm



Fig. S3 LM images (40X) of MFC under different solids loadings. Scale bar = 50 μ m

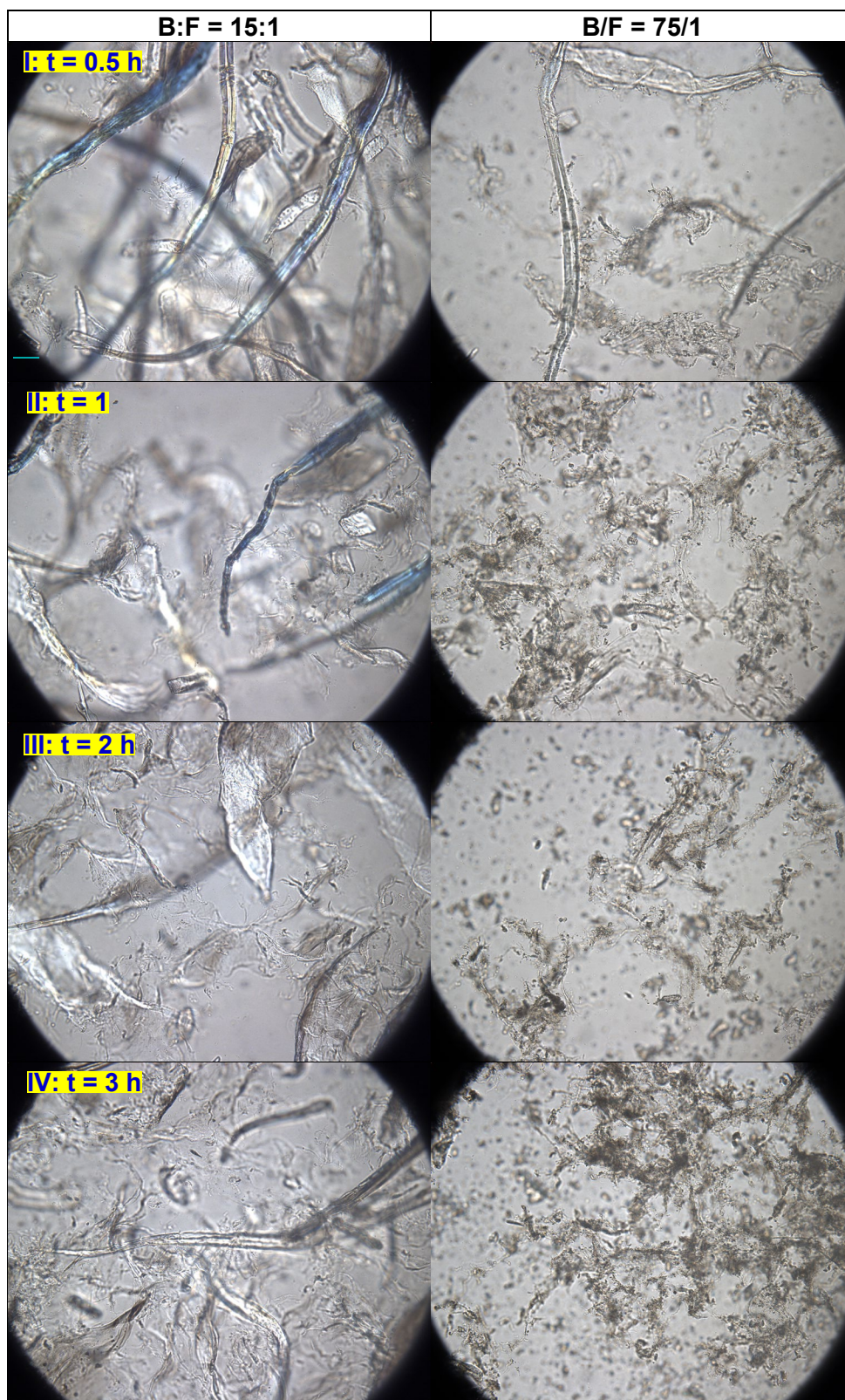


Fig. S4 LM images showing the effect of ball to fiber mass ratio (B/F) at a very low solids loading of 1% on time-dependent morphologies of fibrillated cellulosic fibers from planetary ball milling. Mill spinning speed was 600 rpm. Scale bar = 100 μm .

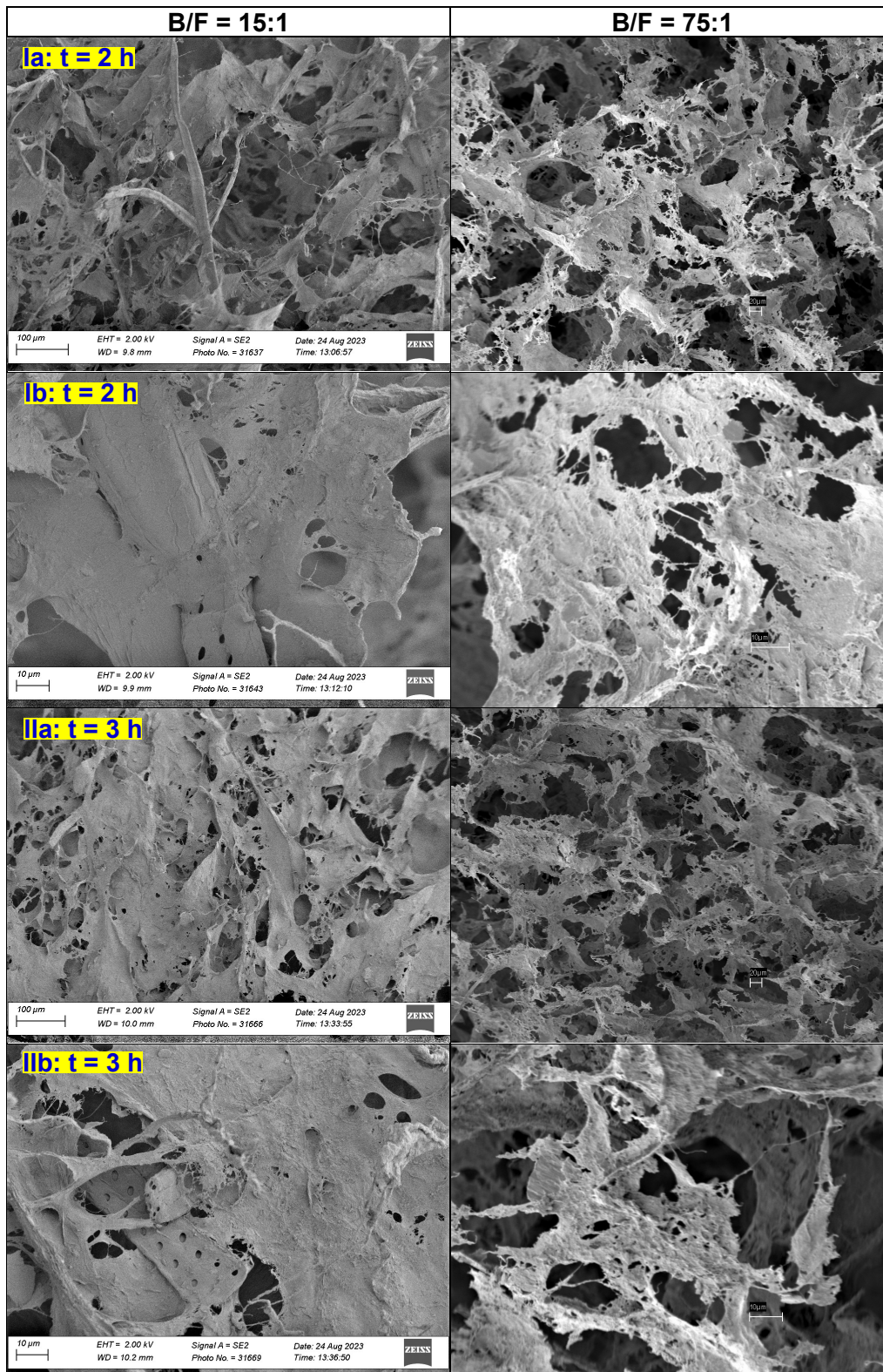


Fig. S5 SEM images showing the effect of ball to fiber mass ratio (B/F) at a very low solids loading of 1% on the resultant MFC microstructures. Mill spinning speed was 600 rpm.

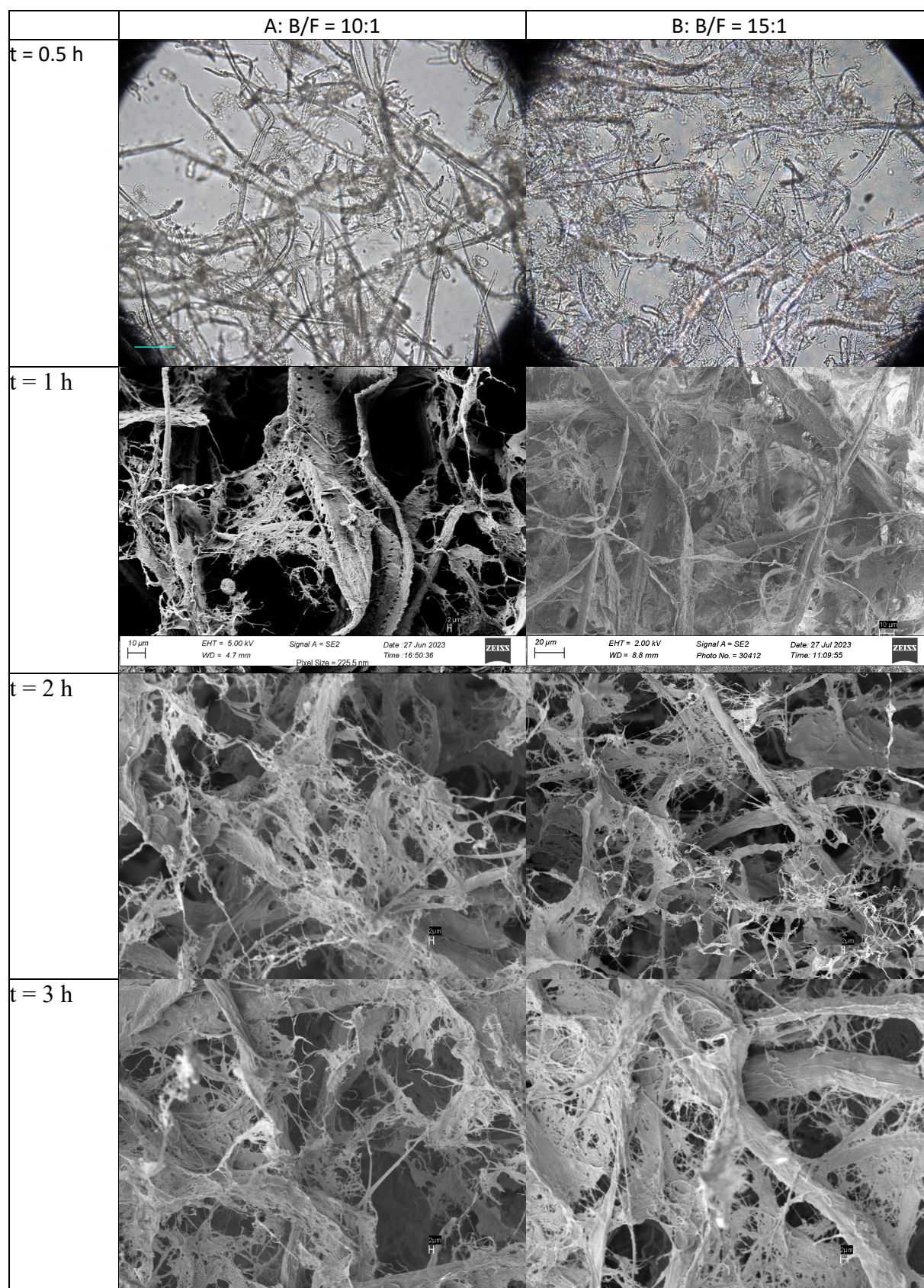


Fig. S6 Comparisons of the morphologies of MFCs produced at different ball to fiber mass (B/F) loadings with solids loading of 28%. LM Scale = 100 μ m.

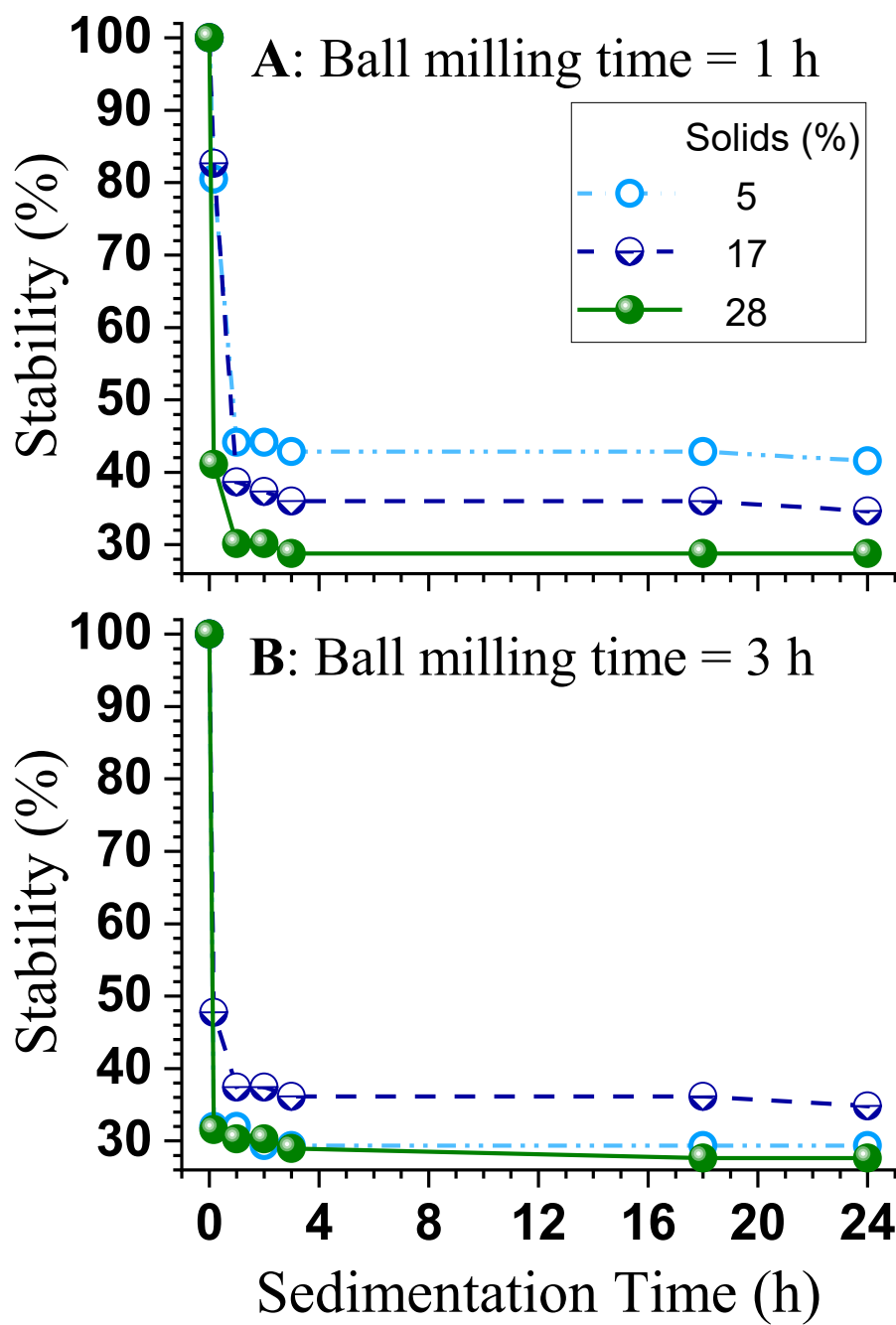


Fig. S7. Time-dependent stability of two set MFC suspensions from ball milling at various fiber solids loading for 1 h and 2 h.

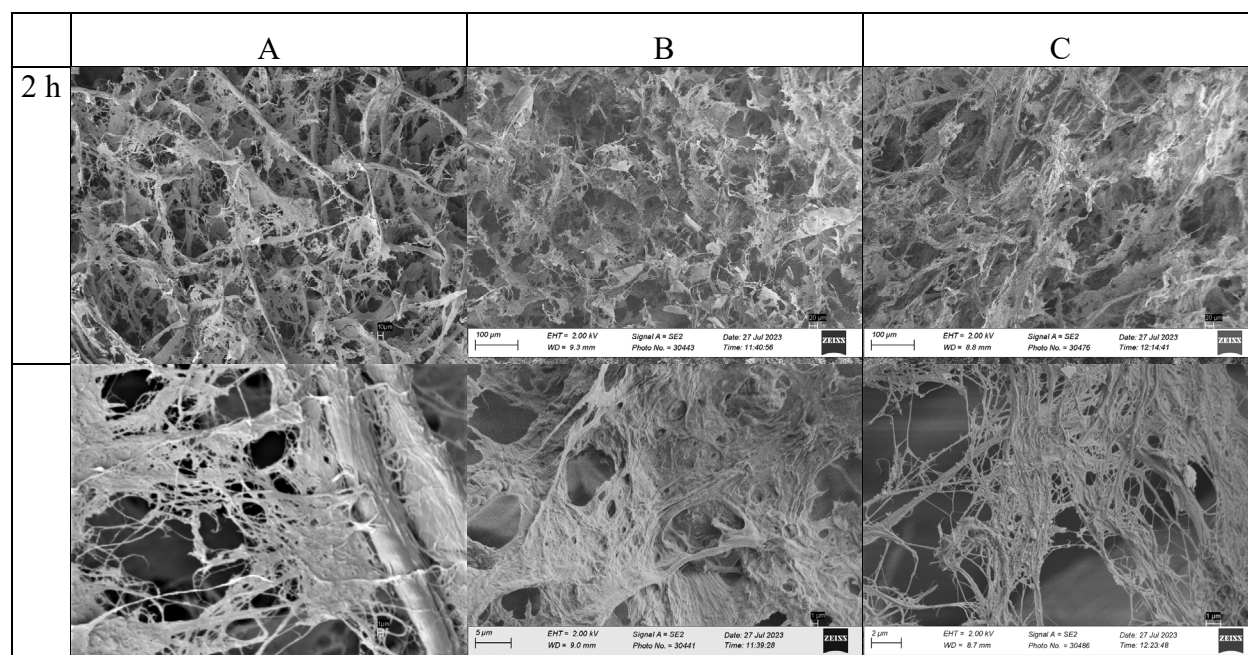


Fig. S8 Effects of pulp fiber pretreatment on ball milling BKHP for 2 h at solids loading of 28% observed by SEM. Column A: Untreated BKHP; Column B: enzymatic pretreated BKHP using FR; Column C: Mechanically refined BKHP to 200 mL CSF using a PFI mill.

Table S1 Chemical composition (%) of bleached kraft hardwood pulp fibers.

Klason lignin	0.6
Acid soluble lignin	2.1
Total lignin	2.7
Glucan	72.7
Xylan	23.1
Mannan	0.6
Ash	0.3

Table S2 Ball-milling conditions and sample labeling

Sample No	Ball to fiber (w/w)	Milling time (h)	Milling solids (%)	Pretreatment
0	N/A	0	N/A	Original BKHP
1	10:1	0.5	28	None
2	10:1	1	28	None
3	10:1	2	28	None
4	10:1	3	28	None
5	10:1	6	28	None
6	15:1	0.5	28	None
7	15:1	1	28	None
8	15:1	2	28	None
9	15:1	3	28	None
10	15:1	0.5	17	None
11	15:1	1	17	None
12	15:1	2	17	None
13	15:1	3	17	None
14	15:1	0.5	5	None
15	15:1	1	5	None
16	15:1	2	5	None
17	15:1	3	5	None
34	15:1	0.5	1	None
35	15:1	1	1	None
36	15:1	2	1	None
37	15:1	3	1	None
18	75:1	0.5	1	None
19	75:1	1	1	None
20	75:1	2	1	None
21	75:1	3	1	None
22	N/A	0	N/A	Endoglucanase
23	15:1	0.25	28	Endoglucanase
24	15:1	0.5	28	Endoglucanase
25	15:1	1	28	Endoglucanase
26	15:1	2	28	Endoglucanase
27	15:1	3	28	Endoglucanase
28	N/A	0	N/A	PFI mill refining
29	15:1	0.25	28	PFI mill refining
30	15:1	0.5	28	PFI mill refining
31	15:1	1	28	PFI mill refining
32	15:1	2	28	PFI mill refining
33	15:1	3	28	PFI mill refining