Supplementary data

Hydrogel MPs	Crystallinity	Max swelling ratio (SGF) (%)	Max swelling ratio (SIF) (%)
	(%)		
208035	17.67	519.45 ± 13.85	6113.71 ± 26.77
208050	20.56	367.49 ± 23.63	4840.83 ± 43.69
307035	21.11	447.21 ± 10.92	5220.55 ± 52.94
307050	19.93	266.47 ± 20.91	4476.47 ± 13.19
406035	20.31	207.77 ± 14.33	3997.77 ± 72.86
406050	17.29	174.67 ± 17.01	3708.00 ± 54.37
BNC	32.64		

Table S1: Results of crystallinity from XRD analysis and maximum swelling capacity in SGF and SIF.



Figure S1: (A) Apparent permeability coefficient. (B) Flux. (C) Enhancement ratio relative to control. Significant differences compared to without MPs control with p < 0.001 and p < 0.05 were indicated with *** and * respectively.



Figure S2: Positive control ConA-treated splenocytes. (A) IFN- γ production from splenocytes treated with ConA for 84 hours. (B) IL-2 secretion from splenocyte treated with ConA for 30 hours (C) Percentage of CD69 activation on T- and B-splenocytes from different groups of mice. Splenocytes were treated with ConA as a positive control. Results are shown as mean ± SD of the percentage of CD69 positive with respect to CD4+, CD8+, and CD19+ from each group (n = 6).

The positive control ConA-treated splenocytes showed dramatic elevation in the production of the TH1 immune profile cytokines (Figure S2A & S2B). ConA is a polyclonal T cell stimulator, with whom

splenocytes proliferate at a very fast scale, even at a small concentration of 5 μ g/mL, as shown by Liu et al.¹. Our lymphoproliferation results from ConA treatments backed this report as the proliferation was almost 3 times greater than in the non-treated cels (Figure 6E). A separate study also suggested that ConA works at the genetic level and boosts the expression of various cytokines genes which include IFN- γ and IL-2².



Figure S3: The nano-width diameter of BNC. Cellulose fibers can be considered nanosize if their diameter is less than 100 nm. In this study, nanosize cellulose fibers with a diameter less than 100 nm were successfully produced using high shear homogenization, thus, they are known as BNC.



Figure S4: The synthesis process of BNC/PAA hydrogel MPs

1. Liu, Y. H.; Vaghjiani, V.; Tee, J. Y.; To, K.; Cui, P.; Oh, D. Y.; Manuelpillai, U.; Toh, B.-H.; Chan, J. Amniotic epithelial cells from the human placenta potently suppress a mouse model of multiple sclerosis. *PloS one* **2012**, *7*, (4), e35758.

2. Wang, Y.; Gao, B.; Tsan, M.-F. Induction of cytokines by heat shock proteins and concanavalin A in murine splenocytes. *Cytokine* **2005**, *32*, (3-4), 149-154.