An engineered bionic nanoparticle sponge as a cytokine trap and reactive oxygen species scavenger to relieve disc degeneration and discogenic pain

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Supplementary information

Table S1. PCR primer information

Primer	Sequence
iNOS-F	TGGAGCGAGTTGTGGATTG
iNOS-R	TGAGGGCTTGGCTGAGTGA
TNF-α-F	GCGGTGCCTATGTCTCAG
TNF-α-R	TCCTCCACTTGGTGGTTT
IL-6-F	ATTTCCTCTGGTCTTCTGG
IL-6-R	TGGCTTTGTCTTTCTTGTTA
TAC1-F	TGACCAAATCAAGGAGGC
TAC1-R	CAAAGAACTGCTGAGGCT
CGRP-F	CCTGGTTGTCAGCATCTT
CGRP-R	CTCAGCCTCCTGTTCCTC
GAPDH-F	ATTCAACGGCACAGTCAA
GAPDH-R	TTAGTGGGGTCTCGCTCC

Table S2. Western blot antibody information

Antibody	Dilution ratio	CAS	Company
MMP3	1:1000	17873-1-AP	Proteintech, China
MMP13	1:1000	18165-1-AP	Proteintech, China
SOX9	1:1000	ab185966	Abcam, China
COL2A1	1:1000	28459-1-AP	Proteintech, China
CD14	1:1000	17000-1-AP	Proteintech, China
TLR4	1:1000	19811-1-AP	Proteintech, China
F4/80	1:1000	ab300421	Abcam, China
CD120a	1:1000	ab223352	Abcam, China
Na^+-K^+-ATPase	1:3000	14418-1-AP	Proteintech, China
FLAG	1:1000	20543-1-AP	Proteintech, China
GAPDH	1:3000	10494-1-AP	Proteintech, China

Table S3. Immunofluorescent antibody information

Antibody	Dilution ratio	CAS	Company
MMP3	1:100	ab52915	Abcam, China
MMP13	1:100	ab39012	Abcam, China
SOX9	1:100	ab185966	Abcam, China
COL2A1	1:100	ab34712	Abcam, China
CD68	1:100	ab283654	Abcam, China
iNOS	1:100	ab178945	Abcam, China
TAC1	1:100	13839-1-AP	Proteintech, China
CGRP	1:100	ab283568	Abcam, China
c-FOS	1:100	ab222699	Abcam, China
GFAP	1:100	ab7260	Abcam, China
PGP9.5	1:100	ab108986	Abcam, China

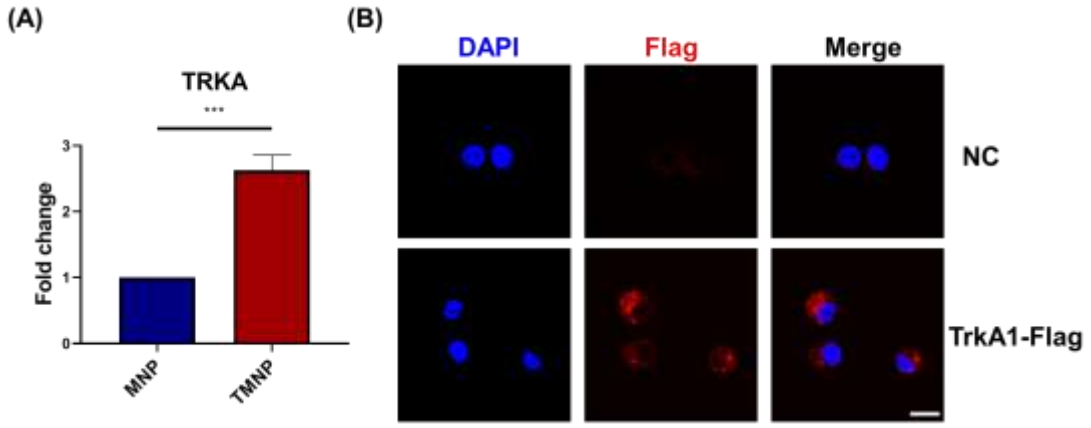

Figure S1. Evidence of high expression of TrkA in macrophage cell membranes. (A) Quantitative analysis of the western blot shown in Figure 1G of the effect of overexpression of TrkA on

macrophage cell membranes. The fold change was normalized to MNP group. (B) Fluorescence showing TrkA expression on the cell membrane. Bars = 20 μm. Data are presented as the mean ± SD (n = 3), ***: $p < 0.001$.

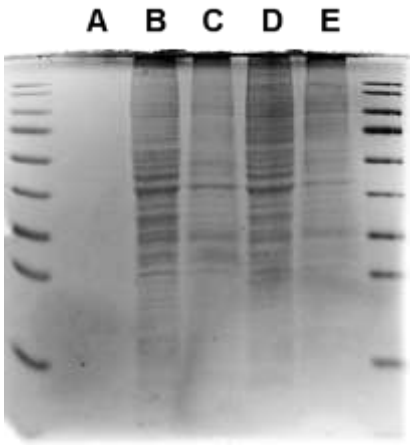

Figure S2. Protein distribution of different materials. (A) MnO_2; (B) MNP; (C) MnO_2@MNP; (D) TMNP; (E) MnO_2@TMNP.

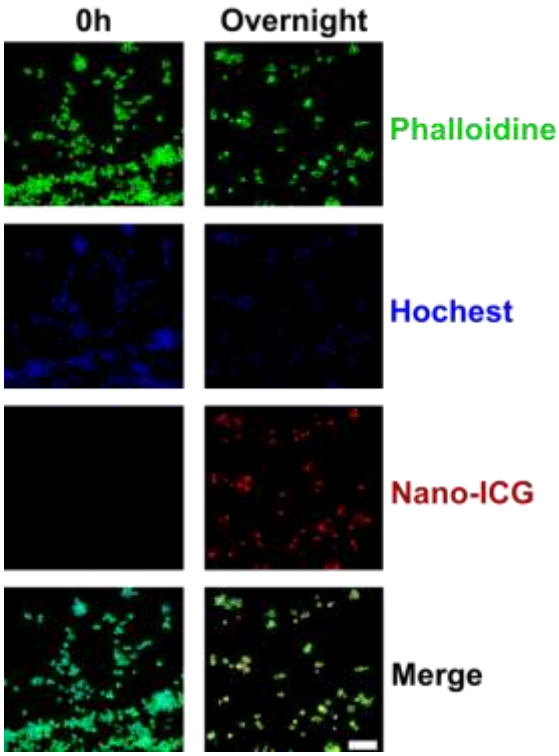

Figure S3. Uptaking of MnO_2@TMNP into macrophages. MnO_2 particles were preloaded with ICG before they were encapsulated into TMNP that was not loaded with fluorescent dyes. The cytoskeleton of the macrophages was stained by FITC-phalloidin. Bars = 100 μm.

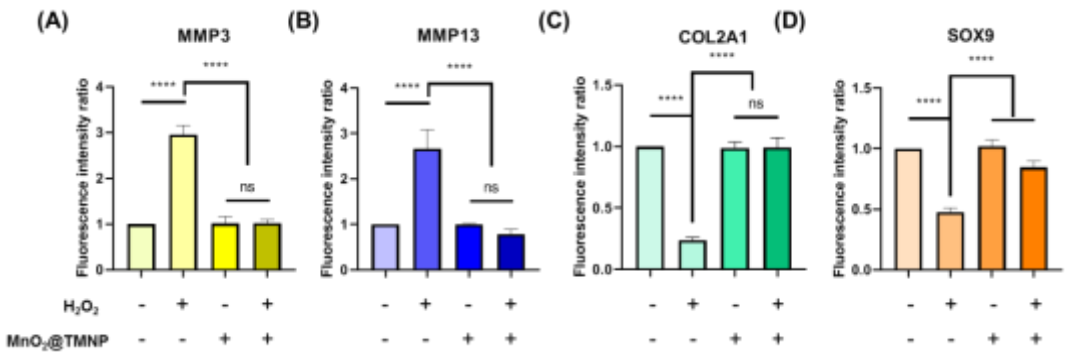

Figure S4. Statistical results of immunofluorescence of (A) MMP3, (B) MMP13, (C) COL2A1, and (D) SOX9 in treated nucleus pulposus cells. The ratio was normalized to H_2O_2(-)/MnO_2@TMNP (-) group. Data are presented as the mean ± SD (n = 3). ns, nonsignificant. ****: $p < 0.0001$.

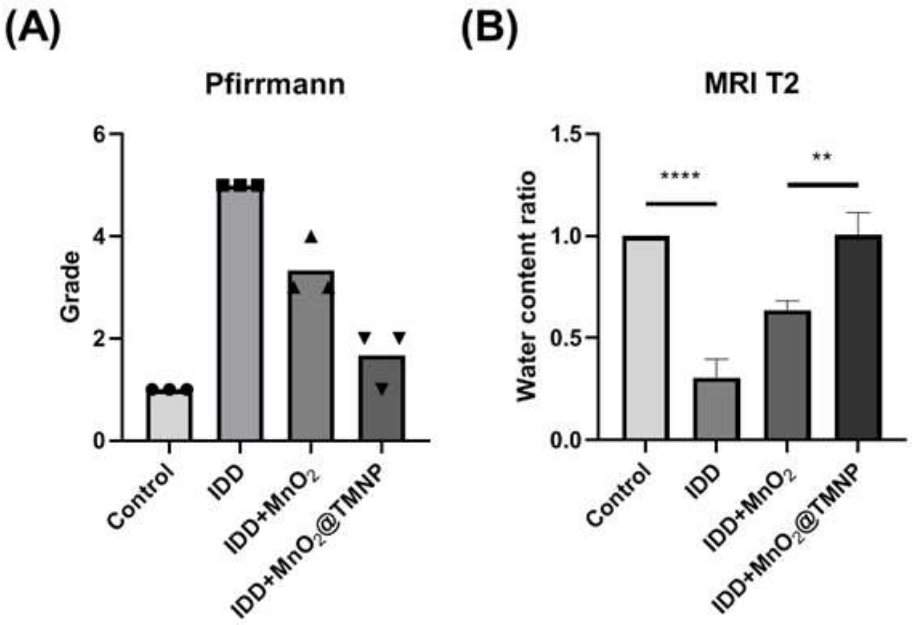

Figure S5. Statistics of the (A) Pfirrmann score and (B) water content of treated IVDs analyzed by MRI. The ratio was normalized to control group. Data are presented as the mean ± SD (n = 3). **: $p < 0.01$. ****: $p < 0.0001$.

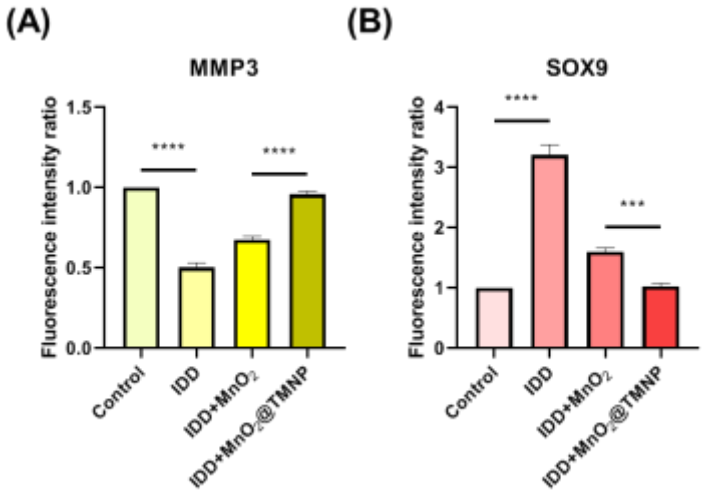

Figure S6. Statistical analysis of immunofluorescence staining of (A) MMP3 and (B) SOX9 in treated IVD tissue. The ratio was normalized to control group. Data are presented as the mean ± SD (n = 3). ***: $p < 0.001$. ****: $p < 0.0001$.

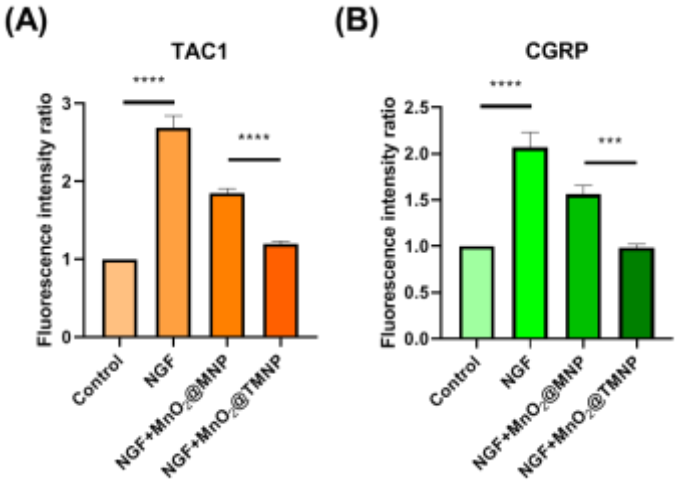

Figure S7. Statistics of the immunofluorescence staining results of (A) TAC1 and (B) CGRP in treated neurocytes. The ratio was normalized to control group. Data are presented as the mean ± SD (n = 3). ***: $p < 0.001$. ****: $p < 0.0001$.

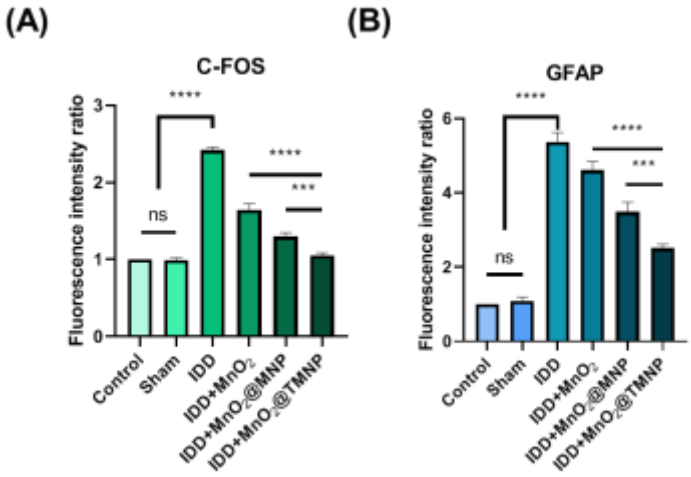

Figure S8. Immunofluorescence statistics of (A) c-FOS and (B) GFAP in the spinal cord innervating the coccygeal vertebra in different treatment groups. The ratio was normalized to control group. Data are presented as the mean ± SD (n = 3). ns, nonsignificant. **: $p < 0.01$. ***: $p < 0.001$. ****: $p < 0.0001$.

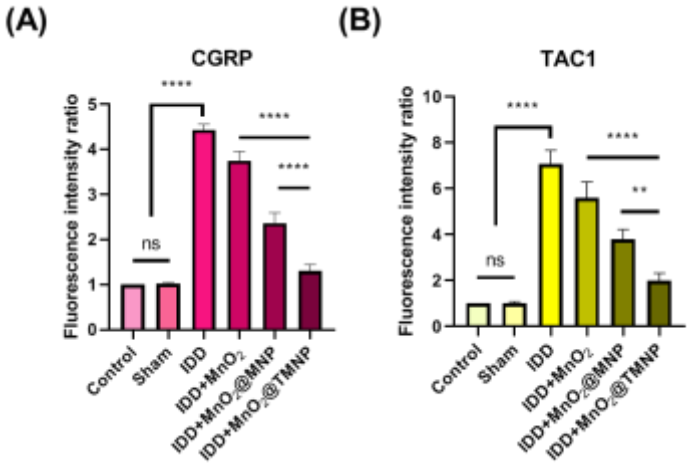

Figure S9. Statistical analysis of CGRP and TAC1 immunofluorescence staining of the ganglion innervating the coccygeal vertebra in different treatment groups. The ratio was normalized to control group. Data are presented as the mean ± SD (n = 3). ns, nonsignificant. **: $p < 0.01$. ***: $p < 0.001$. ****: $p < 0.0001$.