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Black phosphorus thermosensitive hydrogels loaded with bone marrow mesenchymal stem cells-derived exosomes synergistically promote bone tissue defect repair

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Table S1. Primers used for the target genes

Gene	Primer (F = forward; R = reverse)
Alp	F: 5′AACGTGGCCAAGAACATCATCA3′
	R: 5′TGTCCATCTCCAGCCGTGTC3′
Runx-2	F:5’CACAAGTGCGGTGCAAACTT3’
	R:5’AAGAGGCTGTTTGACGCCAT3’
Opn	F:5’AGACTGGCAGTGGTTTGCTT3’
	R:5’AGTGTTTGCTGTAATGCGCC3’
Col1a1	F:5’CCGCTGTCTTCTAGTGTTGCT3’
	R:5’GGATAAGGGGCGCGATGC3’
Gapdh	F:5’GGCACAGTCAAGGCTGAGAATG3’
	R:5’ATGGTGGTGAAGACGCCAGTA3’

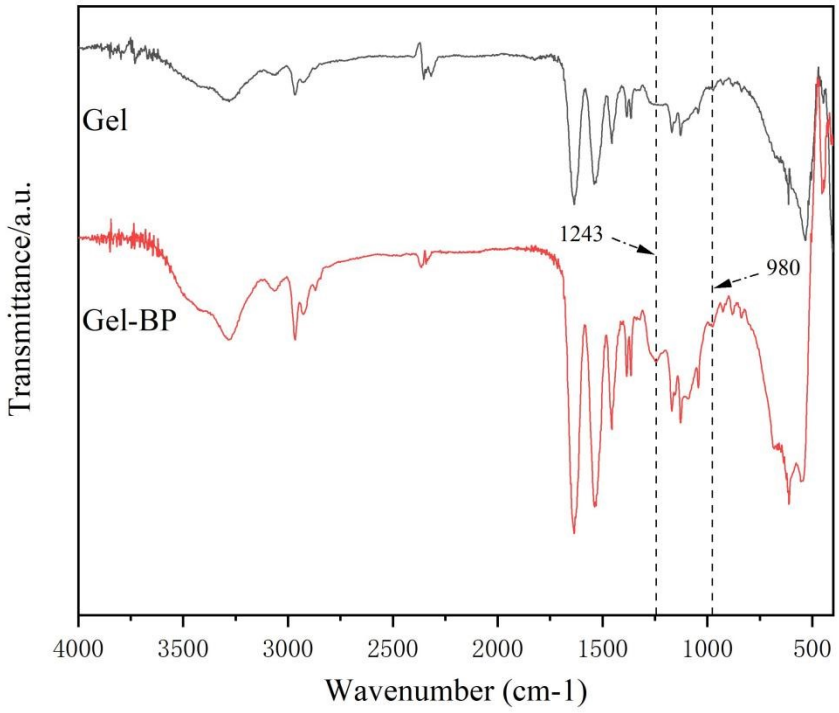

Figure S1: FTIR spectrum of Gel and Gel-BP.

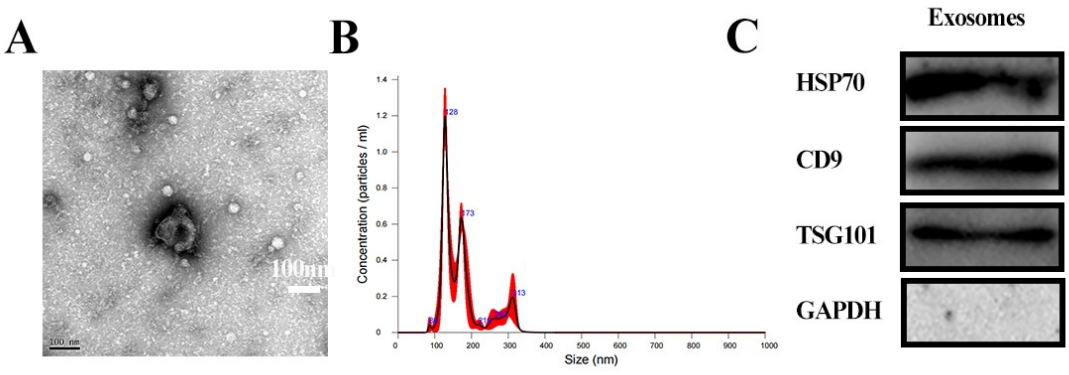

Figure S2: Characterization and identification of exosomes. (A) Image of exosomes morphology under TEM. (B) NTA of exosomes. (C) Western blotting of exosome specific protein markers.

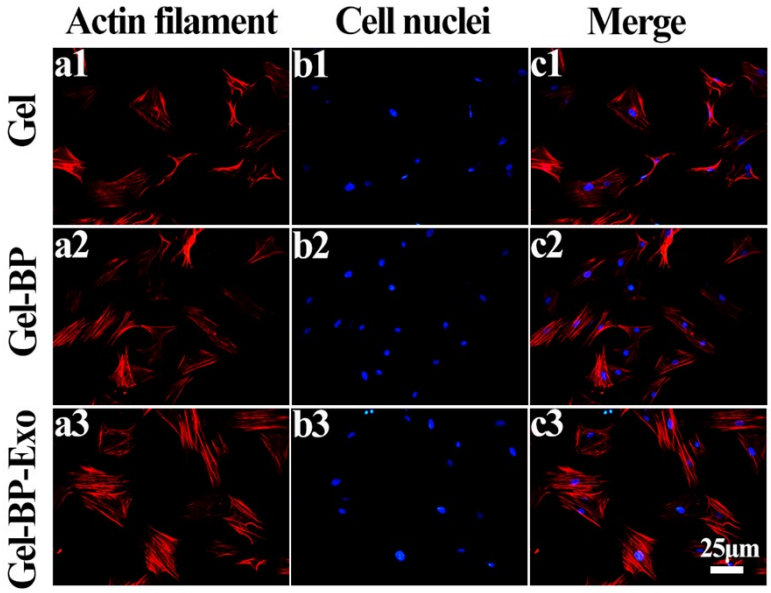

Figure S3: BMSCs were cultured on the surface of the Gel, Gel-BP, and Gel-BP-Exo groups for 24 hours. Red: actin (a1, a2, a3), blue: nucleus (b1, b2, b3), merged: actin and nucleus (c1, c2, c3).

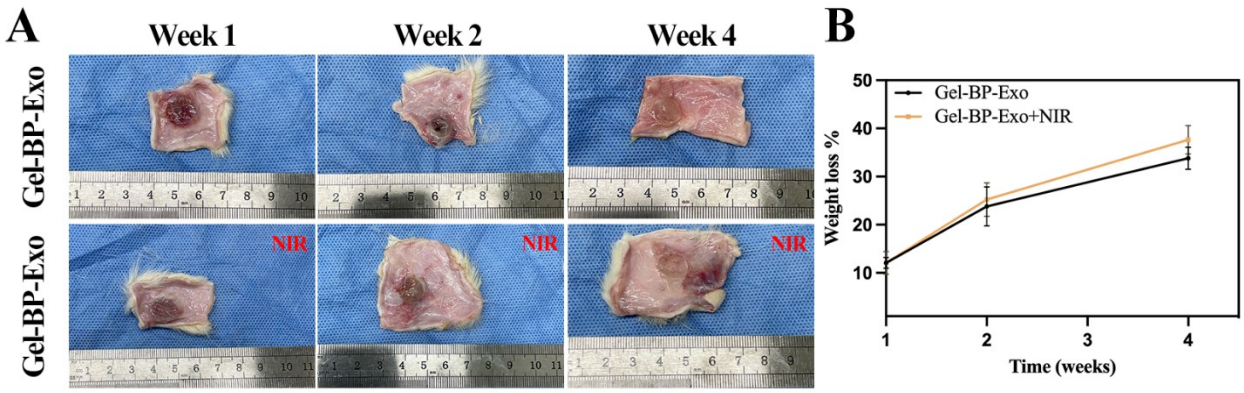

Figure S4: *In vivo* degradation following subcutaneous implantation of the Gel-BP-Exo. (A) Gross view of the hydrogels after 1, 2, and 4 weeks of subcutaneous implantation. (B) Change of hydrogel weight for the remaining hydrogel during *in vivo* degradation.

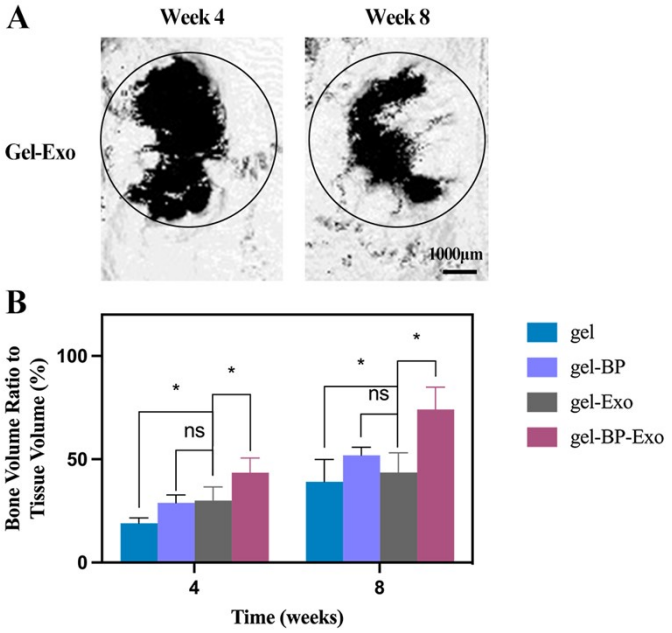

Figure S5: Analysis of bone tissue regeneration *in vivo* by micro-CT. (A) 3D reconstruction images of the defects area after implanting Gel- Exo for 4 and8 weeks. (B) Quantitative analysis of the bone volume ratio to tissue volume based on micro-CT data. （* indicates significant difference compared to Gel-Exo group, $P < 0.05$)

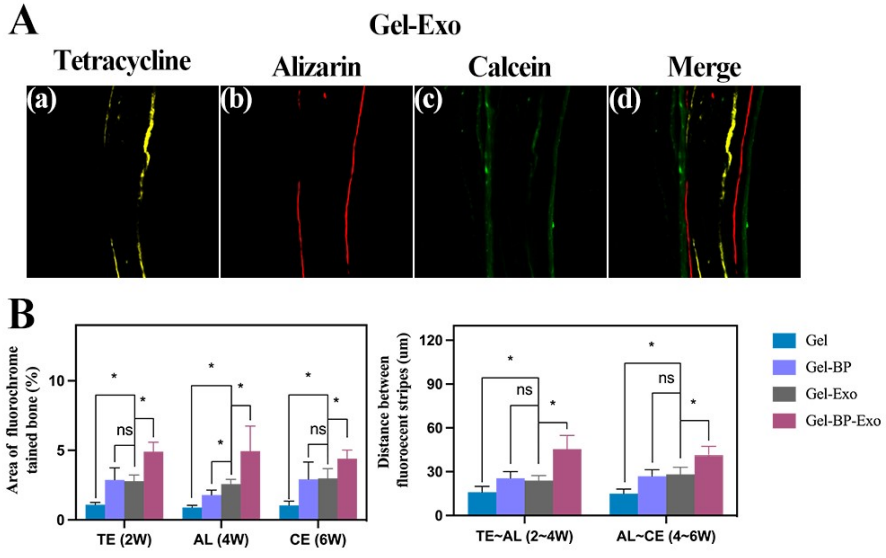

Figure S6: (A) Sequential fluorescent labeling images of four groups implanted *in vivo* for 8 weeks. (B) Quantitative analysis of the area of new formed bone tissue by fluorescent staining and the distance between fluorescent bands of new bone. (*

indicates significant difference compared to Gel-Exo group, P < 0.05)

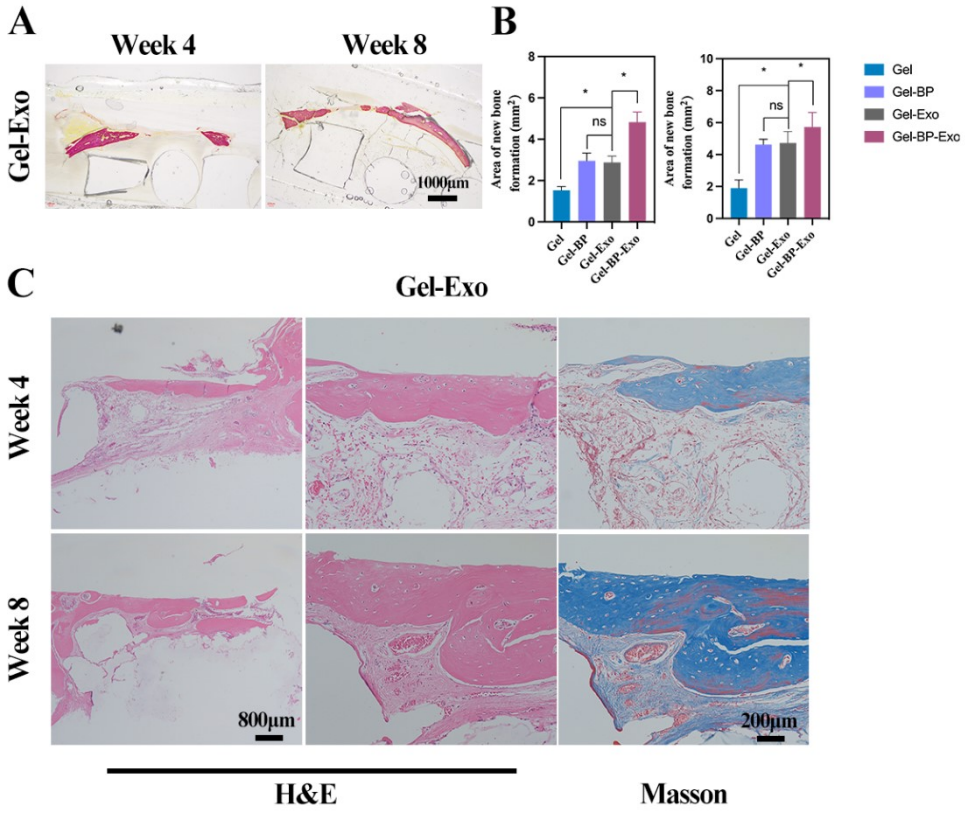

Figure S7: Histological staining analysis of bone tissue regeneration *in vivo*. (A) Van Gieson-stained images of new bone for the Gel-Exo group and (B) corresponding quantitative analysis. (C) Histological images of H&E stained and Masson's trichrome stained bone tissue sections of the Gel-Exo group (* indicates significant difference compared to Gel-Exo group, P < 0.05)

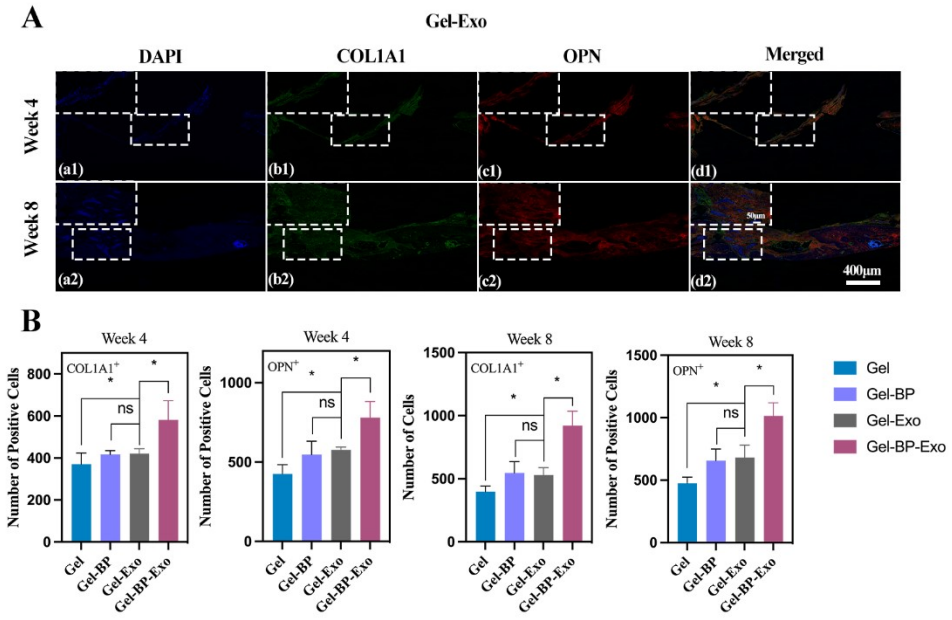

Figure S8: Immunofluorescence staining analysis of bone tissue regeneration *in vivo*. (A) Representative immunofluorescence staining of COL1A1 and OPN in defect areas of Week 4 and Week8. (B) Semi-quantification of positively stained cells in (A). (* indicates significant difference compared to Gel-Exo group, $P < 0.05$)