Supplementary Information

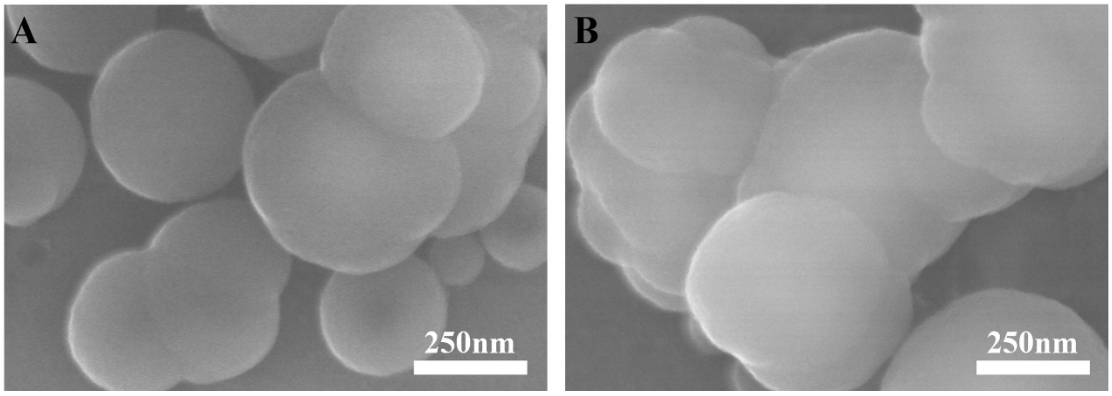

Figure.S1. SEM images of HM20ZS (A) and HM30ZS (B).

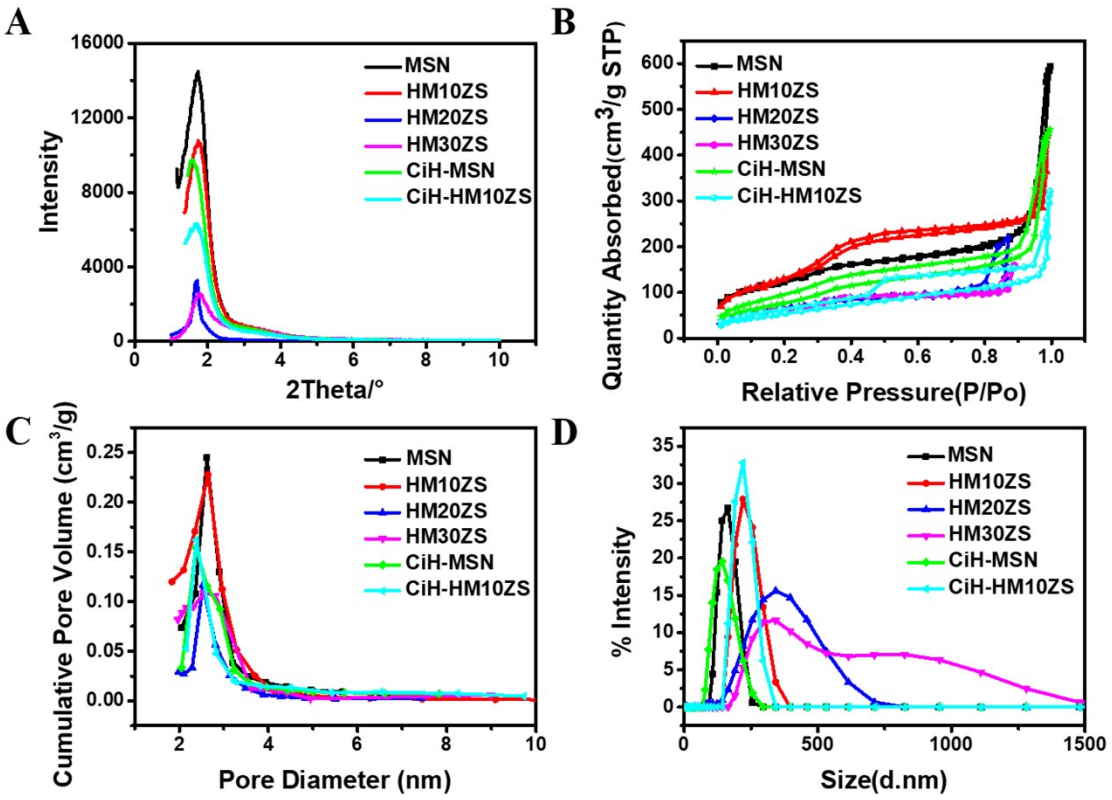

Figure.S2. The characterization of MSN, HMZS (with 10, 20 and 30 mol% Zn), CiH-MSN and CiH-HM10ZS. (A) SAXRD spectrum, (B) N_2 absorption-desorption isotherm, (C) mesopore pore size distribution, (D) the hydrated dynamic particle size distribution.

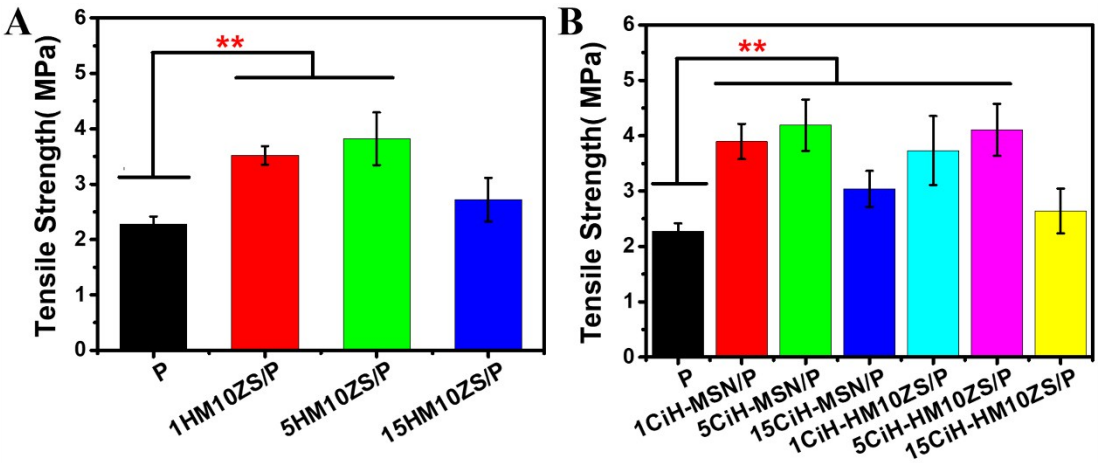

Figure.S3. The tensile strength of the PCL incorporated with different amount of HM10ZS (A); The tensile strength of PCL incorporated with different amount of CiH loaded nanospheres (MSN and HM10ZS) (B) (**P＜0.01).

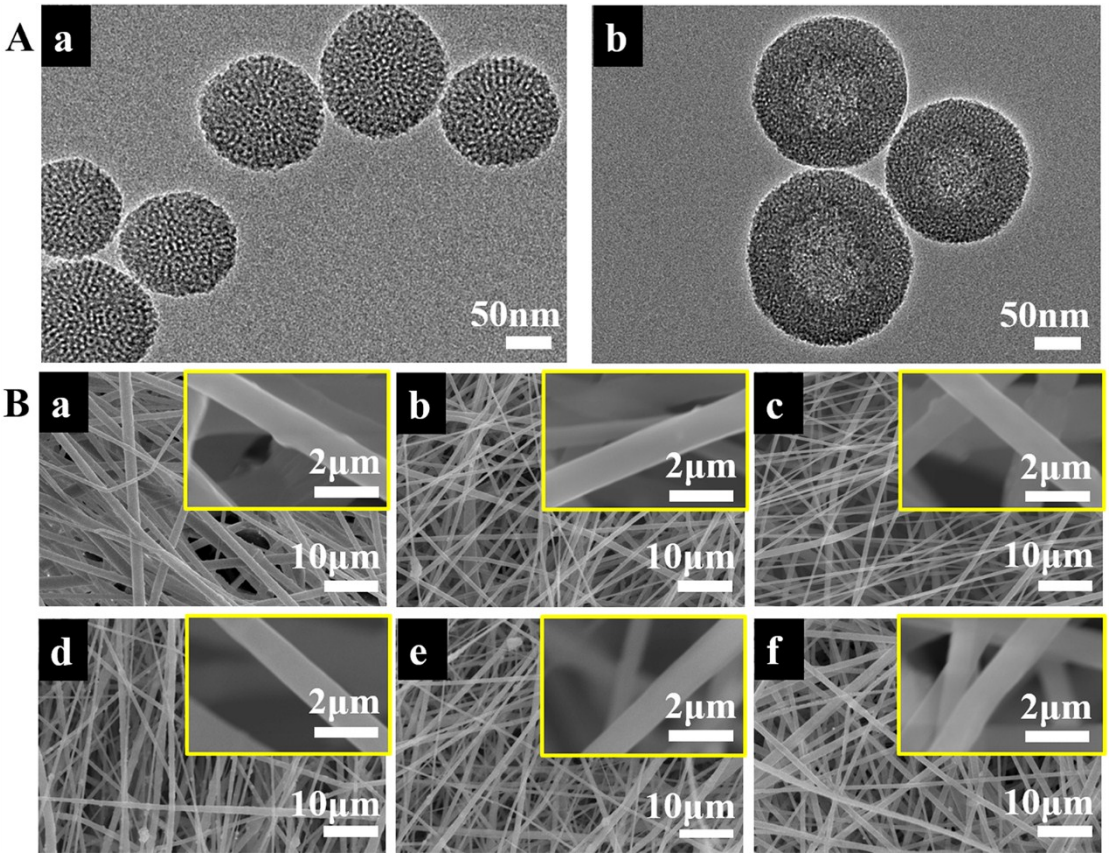

Figure.S4. (A) TEM images of CiH-MSN (a) and CiH-HM10ZS (b); (B) SEM images of CiH-MSN/P nano-composite membranes (a:1CiH-MSN/P, b:5CiH-MSN/P, c: 15CiH-MSN/P) and SEM images of CiH-HM10ZS/P nano-composites membranes (d:1CiH-HM10ZS/P, e:5CiH-HM10ZS/P, f:15CiH-HM10ZS/P).

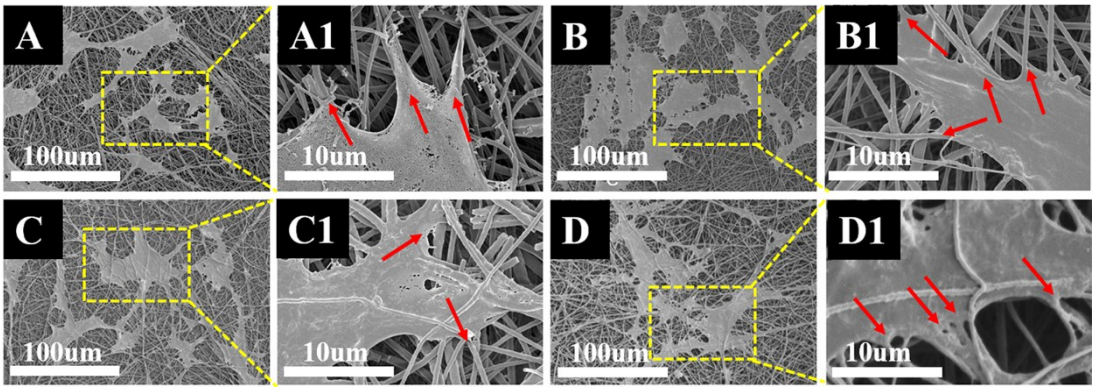

Figure.S5. SEM images of HUVECs after 1 day of growth on PCL nano-composite membranes (A-A1: 1HM10ZS/P; B-B1: P); and HDFs after 1 day of growth on PCL membranes (C-C1: 1HM10ZS/P; D-D1: P). Red arrows in images represent cell tentacles of HUVECs (A1-B1) or HDFs (C1-D1).

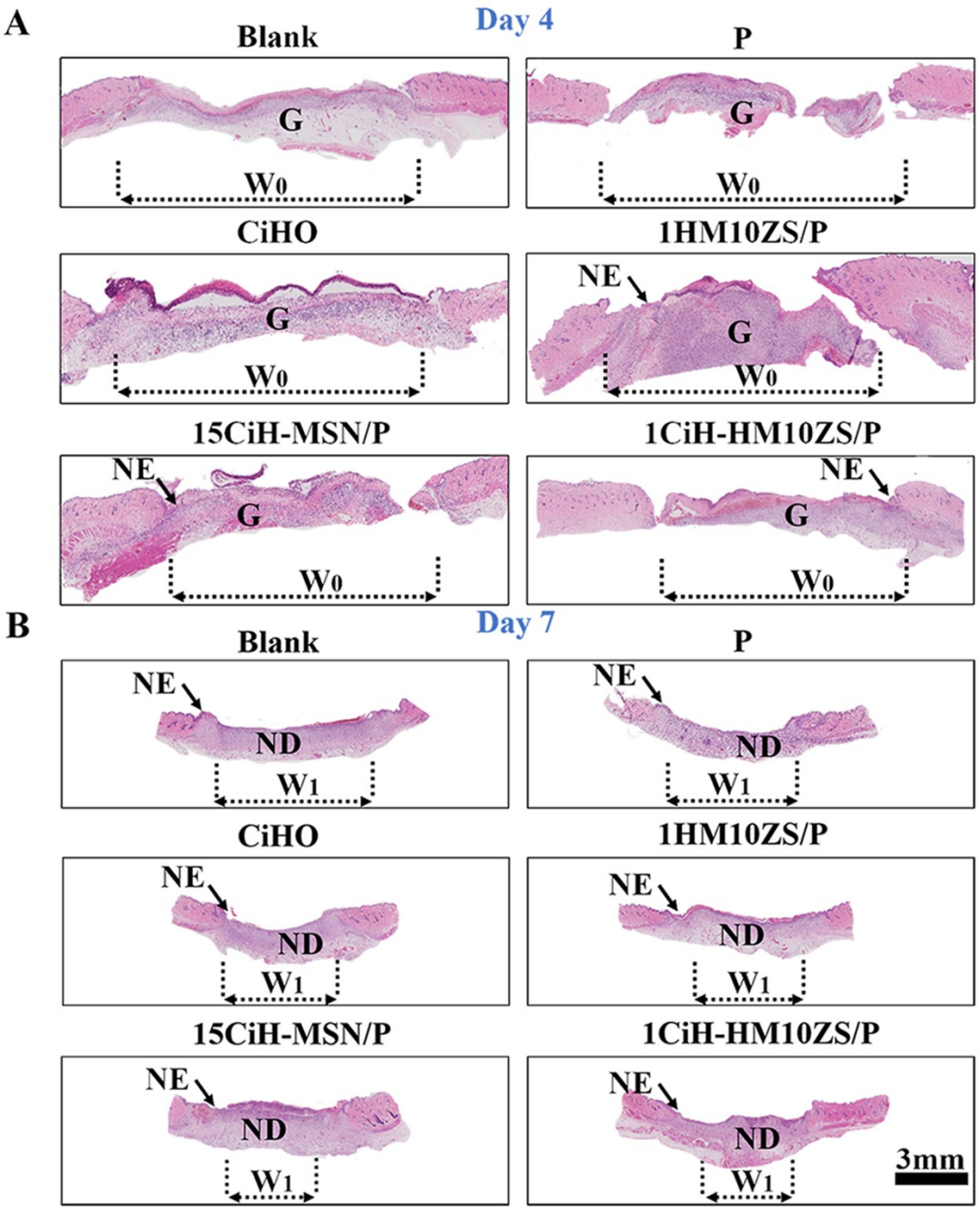

Figure.S6. The H&E staining of whole wounds sections after 4 days (A) and 7 days (B) of treatment with PCL composite membranes (W_0: wound of day 4; W_1: wound of day 7; G: granulation tissue; NE: Newly formed epidermis; ND: Newly formed dermis).

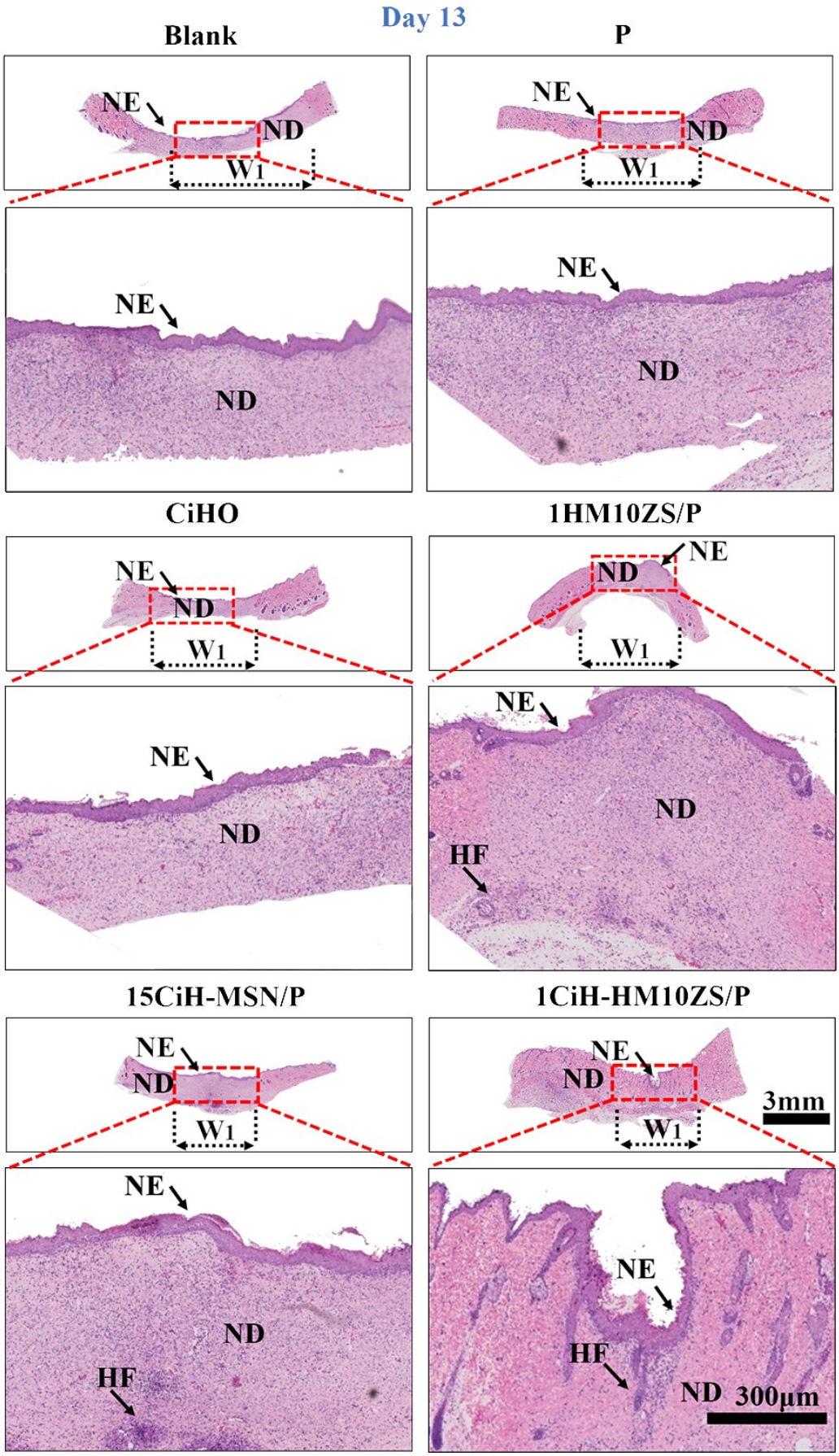

Figure.S7. The H&E staining of whole wounds sections after 13 days of treatment with

PCL nano-composite membranes (W1: wound of day 7; NE: Newly formed epidermis; ND: Newly formed dermis; NF: Newly formed hair follicle).

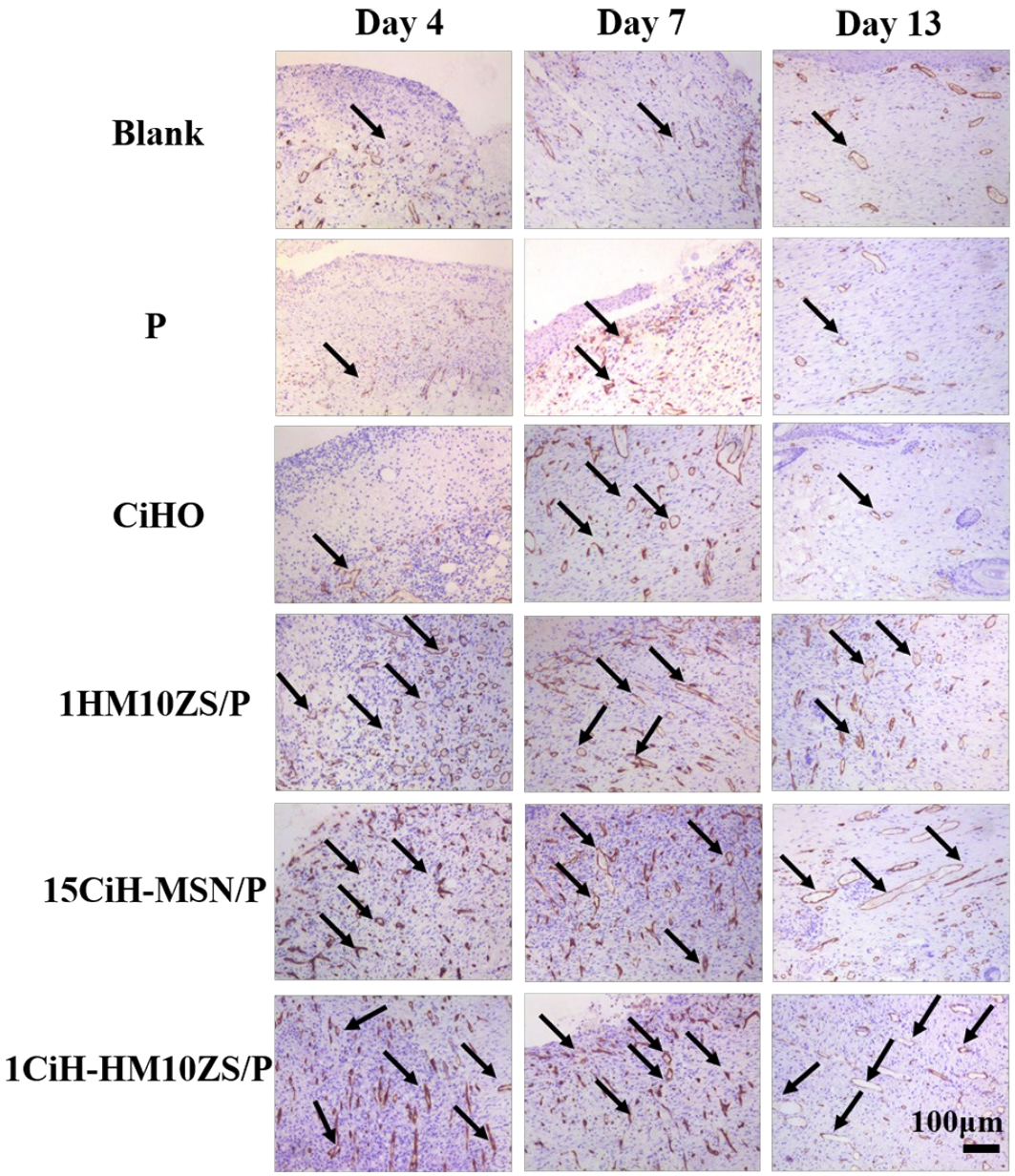

Figure.S8. Immunohistochemical staining of CD31 on wound area sections at day 4, day 7 and day 13 (Black arrows indicated blood vessels).

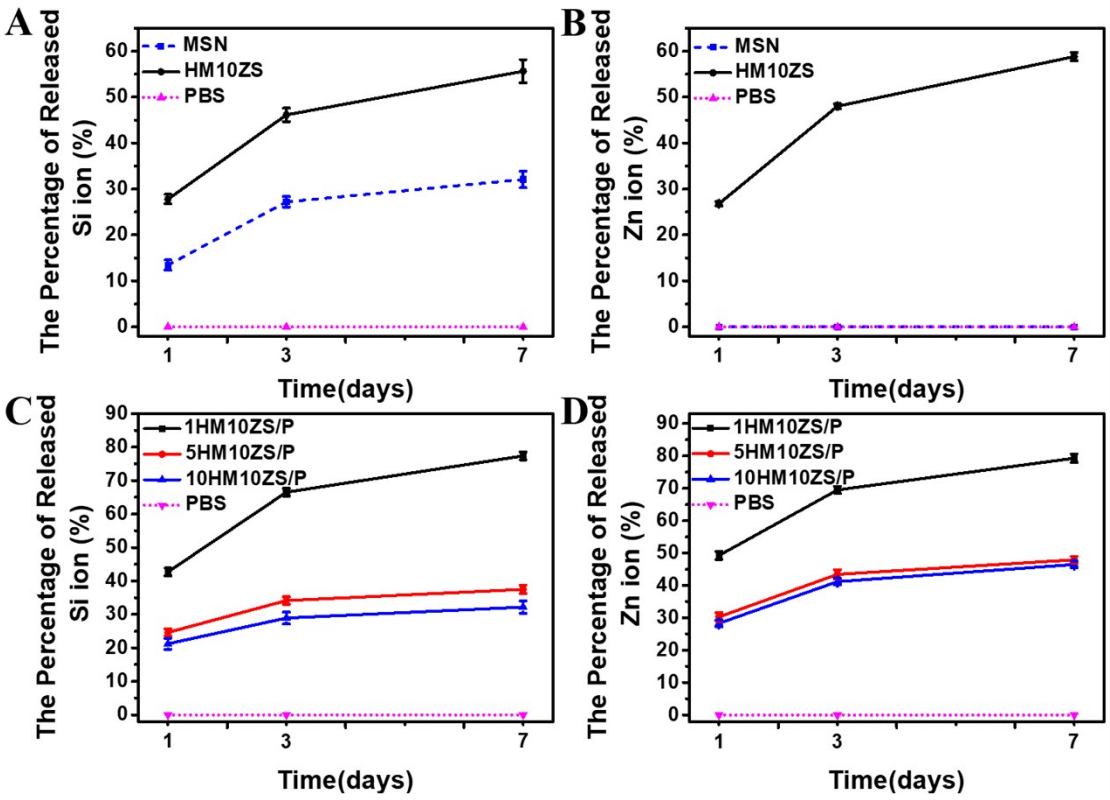

Figure.S9. The percentage of released Si ion (A) and Zn ion (B) of MSN and HM10ZS in PBS; The percentage of released Si ion (C) and Zn ion (D) released from (1, 5, 15) HM10ZS/P nanocomposite membranes in PBS.

Table S1 The molar percentage of Zn in HMZS by ICP-AES analysis, the Zeta-potential, the poly dispersive index (PDI) and the hydrated dynamic particle size by dynamic light scattering analysis.

Particles	Zn（%）	Zeta-potential (mv)	PDI	Hydrated dynamic particle size (nm)
MSN	---	-19.20	0.376	159.80
HM10ZS	7.50	-14.80	0.380	256.60
HM20ZS	15.08	-12.60	0.694	348.00
HM30ZS	19.20	-10.30	0.730	361.60
CiH-MSN	---	-18.70	0.231	149.80
CiH-HM10ZS	7.50	-15.20	0.250	249.20

Table S2 The Zn ion and CiH concentrations of PCL nano-composite membranes in the antibacterial test for 24 h and the related inhibition rate.

	1 HM 10ZS/ P	5 HM 10ZS /P	15 HM 10ZS /P	1 CiH-MSN/P	5 CiH-MSN/P	15 CiH-MSN/P	1 CiH-HM 10ZS/P	5 CiH-HM 10ZS/P	15 CiH-HM 10ZS/P
Zn (ppm)	1.12± 0.19	2.57± 0.24	7.60± 0.32	---	---	---	1.43± 0.24	2.87± 0.53	10.40± 0.67
CiH (ppm)	---	---	---	0.11± 0.09	0.29± 0.08	0.72± 0.10	0.75± 0.12	1.39± 0.22	4.12± 0.57
Inhibition (%)	14.89 ±1.92	44.68 ±2.33	96.28 ±0.89	6.50 ±1.72	41.49 ±1.57	74.47 ±2.32	99.68 ±1.19	99.89 ±0.79	100.00