Supporting information

Table. S1 Primers used for RT-PCR

gene	forward primer sequence (5′-3′)	reverse primer sequence (5′-3′)
ALP	ACAAGTGTGGCAGTGGTATT	CTGCTTGAGGTTGAGGTTACA
Col-I	CCAATGGTGCTCCTGGTATT	GTTCACCACTGTTGCCTTTG
Runx-2	GCCACTTACCACAGAGCTATTA	GGCGGTCAGAGAACAAACTA
OCN	TGACTGCATTCTGCCTCTC	CGGAGTCTATTCACCACCTTA C
β-actin	ACAGGATGCAGAAGGAGATTA C	ACAGTGAGGCCAGGATAGA

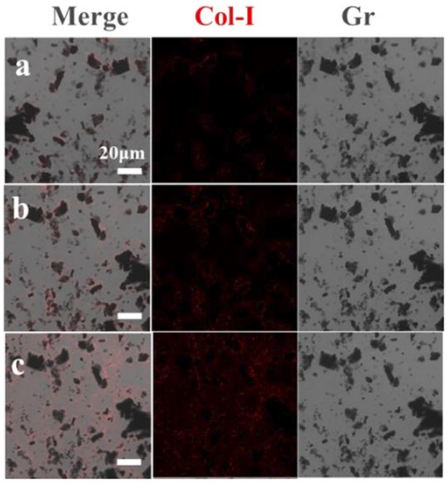

Fig. S1 Z-axis layer scan of CLSM images of LG-ECM: (a) 1/3 height of LG-ECM, (b) 1/2 height of LG-ECM, (c) 2/3 height of LG-ECM.

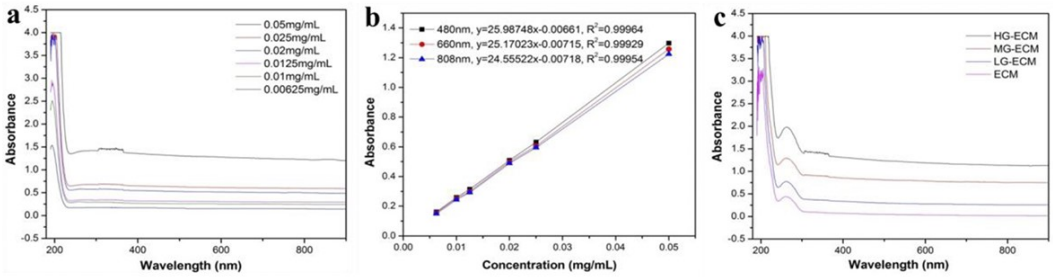

Fig. S2 UV-vis absorption spectra of (a) graphene aqueous solution, (b) standard of graphene aqueous solution at 480 nm, 660 nm, 808 nm; (c) ECM and Gr/ECM films dissolved in 1% SDS solution.

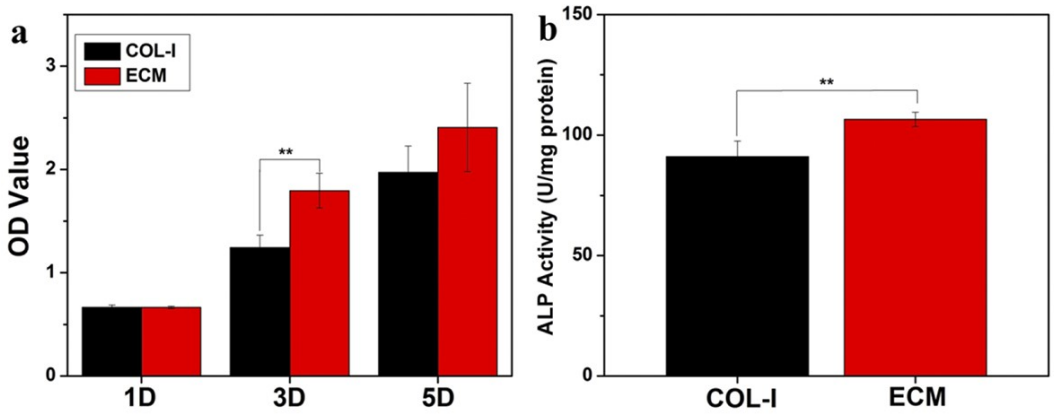

Fig. S3 Biological assessment of BMSCs on the COL-I and ECM film: (a) CCK-8 assay (b) Alkaline phosphatase activity; data represent mean±SD (n=3), **p<0.01. (The COL-I solution was first prepared and spin-coated on Ti substrate at a rotational speed of 4000 rpm for 40s to obtain a collagen-coated Ti substrate.)

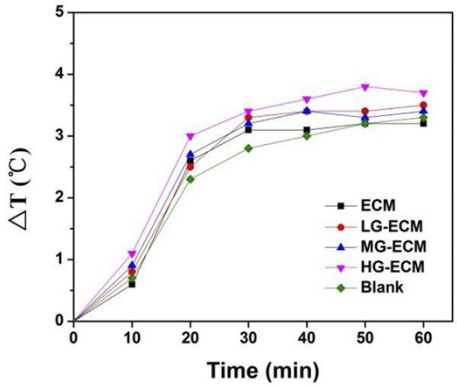

Fig. S4 Photothermal heating curves of the medium immersed with or without (blank) films.

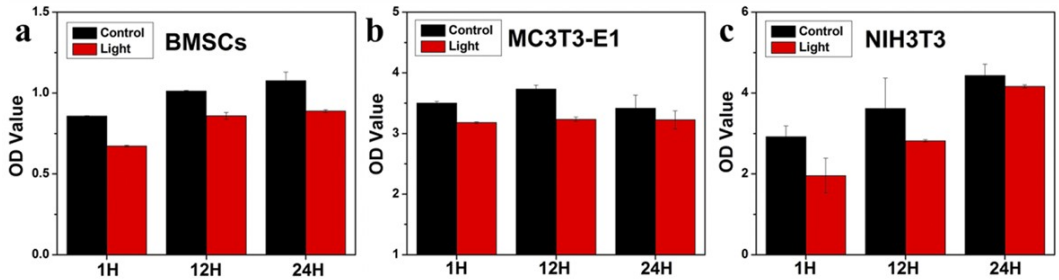

Fig. S5 Cell viability of different cells on LG-ECM with or without photothermal stimulation at 1 h, 12 h, 24 h after stimulation.

Table. S2 Mortality rate ($1-OD_{light}/OD_{control}$) of different cells on LG-ECM after photothermal stimulation at 1 h, 12 h, and 24 h

	1 h	12 h	24 h
BMSC	22.6%	15.1%	17.5%

MC3T3-E1	9.2%	13.4%	5.5%
NIH3T3	32.9%	22.1%	10.7%

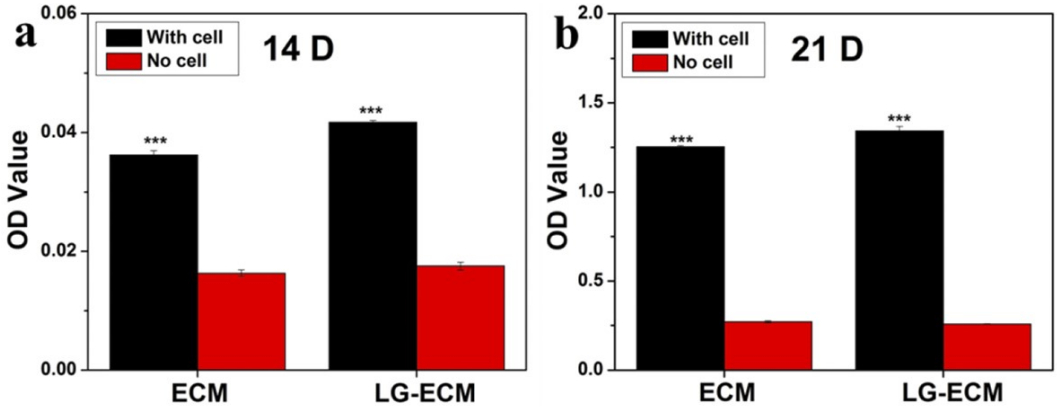

Fig. S6 Quantitative matrix mineralization on ECM or LG-ECM with or without cell seeded after culturing for 14 and 21 days; data represent mean±SD (n=3), ***p<0.001.