Support Information

Injectable Hydrogels Activated with Copper Sulfide Nanoparticles for Enhancing Spatiotemporal Sterilization and Osteogenesis in Periodontal Therapy

Yuting Yang [a, #], Chunbin Xu [a, #], Shengqian Xu [a, #], Yan Li [a], Ke'er Chen [a], Tao Yang [b], Jiaqi Bao [a], Yajing Xu [c], Jingyao Chen,[d] Chuanbin Mao [c, *], Lili Chen [a, *], Weilian Sun [a, *]

[a] *Department of Periodontology, The Second Affiliated Hospital of Zhejiang University, School of Medicine, Hangzhou 310009, P.R. China*

[b] *School of Materials Science and Engineering, Zhejiang University, Hangzhou, Zhejiang, 310027, China.*

[c] *Department of Biomedical Engineering, The Chinese University of Hong Kong, Hong Kong SAR, China*

[d] *Facility for Histomorphology , Zhejiang University School of Medicine, Hangzhou, Zhejiang,*

#: These authors contributed equally.

Corresponding author referred to Weilian Sun, Email: weiliansun@zju.edu.cn , https://orcid.org/0000-0002-3376-2584; Lili Chen, Email: chenlili_1030@zju.edu.cn , https://orcid.org/0000-0002-0620-8844; and Chuanbin Mao, E-mail: cmao@cuhk.edu.hk

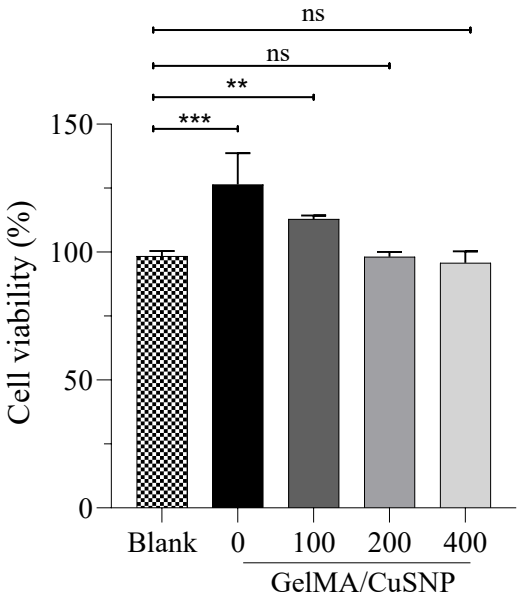

Fig. S1 PTT effect for BMSCs. We applied PTT for BMSCs, and tested the cellular viability using CCK8 assay.

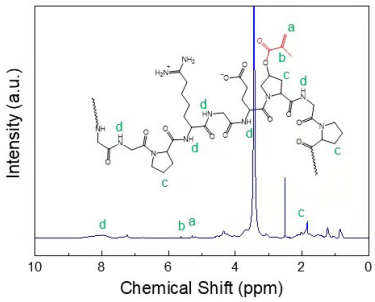

Fig. S2 ^{1}H-NMR results of GelMA hydrogels.

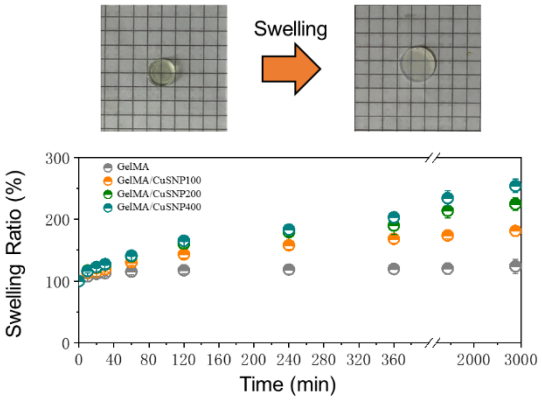

Fig. S3 Swelling ratio of GelMA/CuS hydrogels. Various hydrogels were prepared and shaped to a cylinder (13 mm in diameter and 2 mm in height). Samples were weighed

(W_0) and swelled until equilibrium in PBS thereby. Final materials were collected and weighted (W_t) again at a specific time point. The calculation equation was as the followed: Swelling Ratio (%) =W_t / W_0× 100%

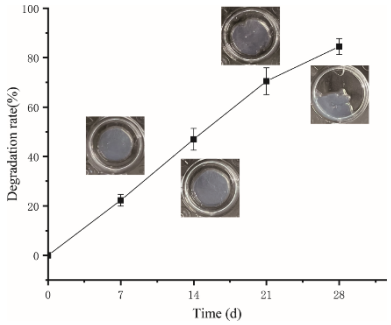

Fig. S4 Degradation rate of GelMA hydrogels.

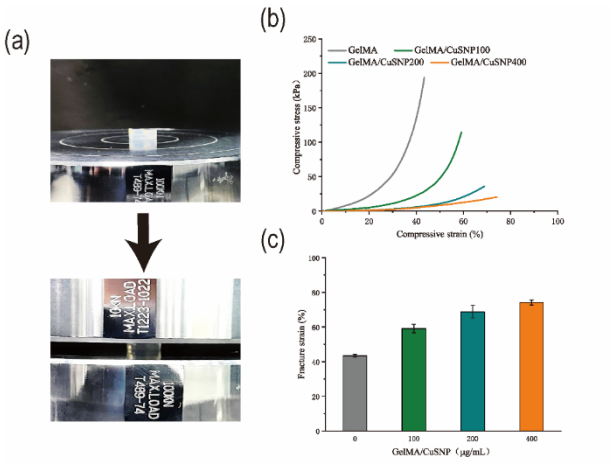

Fig. S5 Compressive property of GelMA/CuSNP hydrogels. Hydrogels were prepared and shaped into a cylinder (13 mm in diameter, 8 mm in height). The samples were tested at the compressive rate of 2 mm per min by the high and low double column tester (Instron 5966, Instron, USA). To reduce the errors in measurement, every sample was tested three times. (a) Schematic diagram to show the operation process; (b) the compressive stress – strain change of GelMA/CuSNP hydrogels; (c) the fracture strain of GelMA/CuSNP hydrogels.

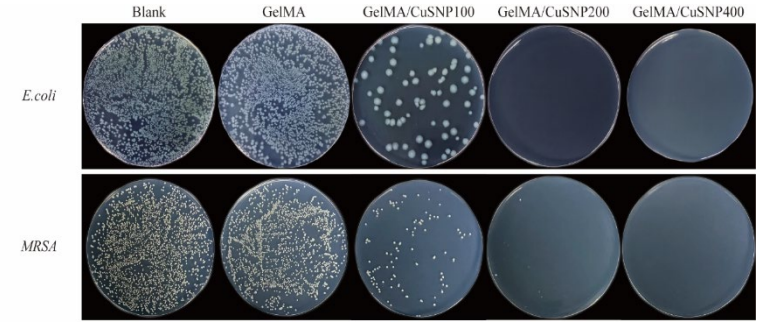

Fig. S6 In vitro antibacterial ability of GelMA/CuSNP hydrogels with NIR. Images of *E.coli*

and *MRSA* colonies co-cultured with GelMA/CuSNP hydrogels after PTT.

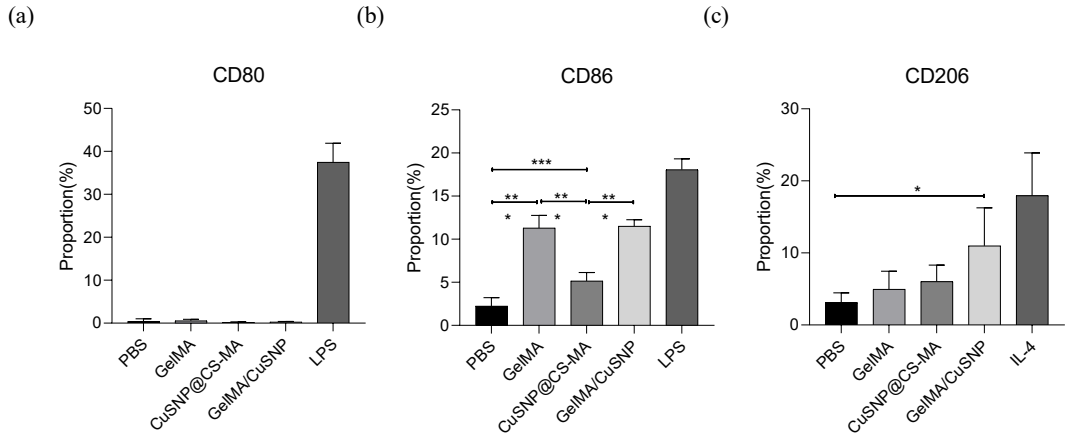

Fig. S7 Macrophage polarization induced by GelMA/CuSNP hydrogels. RAW264.7 cells were incubated with GeMA, CuSNP@CS-MA or GelMA/CuSNP hydrogels. Cells incubated with PBS were thought as negative control. Cells stimulated by lipopolysaccharide (LPS) were as the positive control of M1 macrophages, while IL-4 was set as the positive control of M2 macrophages. The proportion of polarized cells was assured by flow cytometry. Cells expressed both CD80 and CD86 were thought as M1 macrophages, cells expressing CD206 were thought as M2 macrophages. (a) proportion of CD80 positive cells; (b) proportion of CD86 positive cells; (c) proportion of CD206 positive cells. * referred to $P < 0.05$, *** referred to $P < 0.001$.

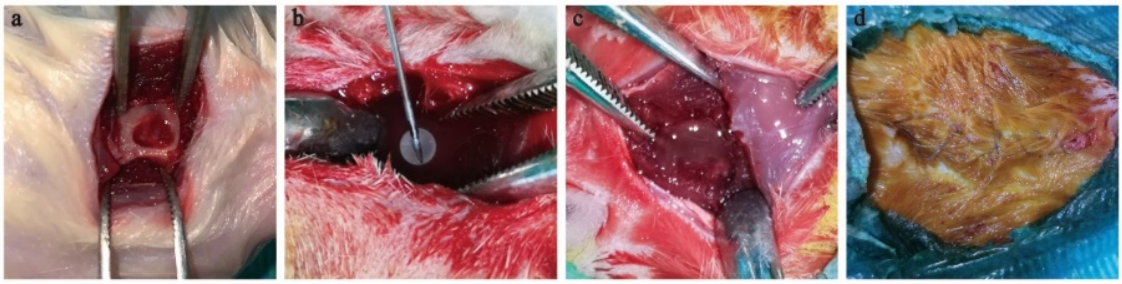

Fig. S8 Schematic illustrations of in vivo osteogenesis in rats' mandibular defect. (a) A critical bone defect (3 mm in width, 1 mm in depth) of first molar was established at the buccal mandibula; (b) 100 μL of GelMA/CuSNP hydrogels were injected to the bone defect; (c) implants were gelatinized after UV light irradiation; (d) tissues and skins were sutured layer by layer.

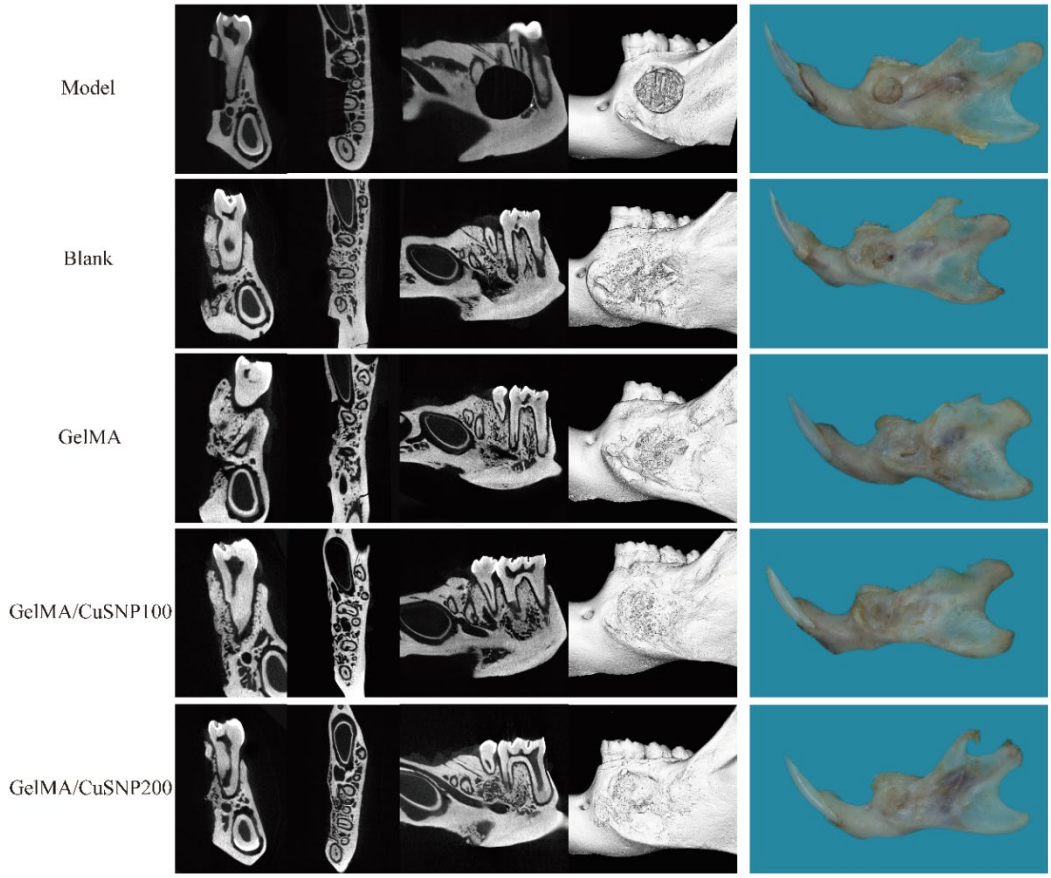

Fig. S9 Visible and radiological images of new bone within rats' mandibular defect after four weeks. From left to right, the pictures displayed the sagittal, transversa and coronal position of new bone, as well as the 3D reconstruction and visible images of the whole mandibular bone of rats.