Supporting Information

**Bioactive Nanocomposite Coatings for Visible-Light Illumination Promoted Surface-Mediated Gene Delivery**

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Supporting methods

The Preparation of AuNPs

AuNPs were prepared by reducing chloroauric acid tetrahydrate (HAuCl₄ 3H₂O, Alfa Aesar) with branched PEI (Mw=25,000, Aldrich) in aqueous solution at room temperature according to literature’s report [1] while with slight changes. The HAuCl₄ aqueous solution was quickly added into PEI aqueous solution with vigorous magnetic stirring for 48 h. The obtained solution was stored at 4 °C for use. The original sizes of AuNPs were characterized by transmission electron microscopy (TEM; JEOL, JEM-2010). The hydrodynamic size and zeta potential of AuNPs were measured by Zetasizer Nano (Nano-ZS90). The light absorption performance of wine red AuNPs solution and composite coating was analyzed with UV-VISIBLE spectrophotometer (Shimadzu, UV-3150).

The harvest, regrowth and gene delivery of cell sheet

Cell sheets were harvest by a visible-light assisted method as reported by our group. [2] Briefly, cells were planted on pn/Si surface at a density of 1×10⁵ cells cm⁻² and cultivated for 5 days. Cells were rinsed three time gently by PBS. Then cell sheets were harvested with visible-light illumination for 10 min. Detached cell sheets was transferred to LF/GFP immobilized Col/AuNPs and re-cultured. After 2 h, cell sheets were illuminated by visible-light for 15 min with a light intensity of 150 mW cm⁻². After cultivation for another 48 h, the GFP expression efficiency was assessed.
Supporting results

Figure S1. (a) TEM image, (b) particle size and zeta potential of prepared AuNPs, (c) UV-Vis absorption spectra of different samples, (d) Size and (z) Zeta potential distribution of prepared AuNPs.

Figure S2. SEM of TiNR. The widths of the nanorods are mostly around 100 nm.
Figure S3. (a) Cell morphology on different samples. (b) OD value of cells planted on samples containing different AuNPs with or without light treatment and (c) Cell morphology on different samples with and without light illumination. Scale bar, 200μm. The cells showed a well spreading on Col/AuNPs while a poor extension on TR after culturing for 1 day. No adverse effects on numbers and spreading morphology of cells were observed for Col/AuNPs composite coatings with different contents with or without visible-light illumination.
**Figure S4.** (a) Fluorescence microscopy image of LF/GFP stained with Helixyte Green after immobilization on TR and Col/AuNPs Scale bar, 200 μm. (b) SEM images of Col/AuNPs with light illumination at an intensity of 0 and 250 mW cm⁻² for 15 min (left: low magnification images, right: high magnification images). Scale bar, 500nm. The distributions of LF/GFP on TR and Col/AuNPs were uniform and Col/AuNPs had a higher loading capacity than TR. When the light intensity was over-high (250 mW cm⁻²), there were many holes on the Col/AuNPs composite coating, which meant that some of the collagen was degraded.
Figure S5. (a) Fluorescence microscopy image of LF/GFP on Col/AuNPs stained with Helixyte Green with different treatment (SR means spontaneous release and LI means light illumination). (c) Amount of pEGFP release from Col/AuNPs with periodic light on and light off (10 min for a cycle). Scale bar, 200 μm. A small amount of LF/GFP adsorbed on the surface of Col/AuNPs after light illumination at 0 h, while there was still abundance LF/GFP after spontaneous release for 48 h. And few LF/GFP was observed on composite coating with light illumination at 24 h and 48 h. When the cycle was set at 10 min (light-on for 5 min and light-off for 5 min), the amount of released LF/GFP was slightly higher during light-on than light-off. This may be attributed to that short-term illumination generated little thermal energy, resulting in an insignificant change in collagen structure.
Figure S6. (a) Image of light mask, Fluorescence microscopy image of remained LF/GFP on (b) TR/Col and (c) Col/AuNPs after release under light illumination with the light mask. Scale bar, 200 μm. Tailored tin foil was used as light mask. For Col/AuNPs, the amount of LF/GFP in the exposed area was much less than that in the unexposed area. However, no obvious difference was observed between exposed area and unexposed area for TR/Col. That implied the release of LF/GFP adsorbed on Col/AuNPs was promoted under visible-light illumination in a spatial controlled manner.

Figure S7. Illustration for preparation of Col/AuNPs composite coating.
Figure S8. Illustration for visible-light illumination treatment. The cold visible-light is illuminated onto the sample from above.

References
