Supporting Information

Light-Responsive and Antibacterial Graphenic Materials as a Holistic Approach to Tissue Engineering.

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Determination of photothermal efficiency values

The efficiency values were calculated by following the protocol described by Feng et al.[28]

$\eta = [h(Tmax - Tsur)] - Qs / [I(1-10-A\lambda)]$ (1)

Being η the photothermal conversion efficiency, h the heat transfer coefficient, S the surface area of the sample cuvette, $Tmax$ the steady-state temperature, $Tsur$ the temperature of the surrounding, Qs the heat associated with the light absorbance of the solution, I the incident laser power, and $A\lambda$ the absorbance of the nanomaterials at a wavelength of 808 nm. Qs is defined through the following equation (2):

$Qs = (mDcD\Delta T) / t$ (2)

Where mD is the mass of the water solution, cD the water heat capacity, ΔT the increase in water temperature, and t the duration of the irradiation. hS, which can be named as θ, is defined as follows (3):

$\theta = (T - Tsur) / (Tmax - Tsur)$ (3)

To solve for θ, a sample time constant τs is defined (4):

$\tau s = (\Sigma i\ mi\ cp,) / hS$ (4)

Also, as reported in the literature[28], the following relation can be established (5):

$t = -\tau s ln\theta$ (5)

Therefore, the time constant is obtained from the equation of the graph when plotting time data vs $ln\theta$. hS can be defined according to the obtained τs, also considering the mass of the solution and the heat capacity of water.

Semi-quantification of printability

The printability values were calculated by following the protocol described by L Ouyang et al.[29]

When the bioink gels ideally, the extruded filament shows a smooth, consistently sized morphology, forming regular grids and square holes in the constructs. In contrast, under-gelation leads to a more liquid-like state, causing the upper layer to merge with the lower layer and creating roughly circular holes in the process. It is known that circularity (*C*) of an enclosed area is defined as:

$C = (4\pi A)/L^2$

where, L means perimeter and A means area. Circles have the highest circularity ($C = 1$)

If the C value approaches 1, the shape is more circular. Circularity for a square shape is π/4. We establish bioink printability (*Pr*) for a square shape using the following function:

$Pr = \pi/(4 \cdot C) = L^2/(16 \cdot A)$

Under ideal gelation or perfect printability, the interconnected channels in constructs exhibit a square shape, with a *Pr* value of 1. A higher *Pr* value indicates a greater bioink gelation degree, while a lower *Pr* value suggests a smaller gelation degree. The *Pr* value for each bioprinted scaffold was determined by analyzing optical images in ImageJ software to calculate the perimeter and area of interconnected channels (n = 3).

Table S1. Elemental analyses of rGO and GP.

GBM	ELEMENTAL ANALYSIS ± SD (%wt)				
	C	H	N	S	O
rGO	80.32 ± 0.74	0.69 ± 0.09	0.027 ± 0.02	0.26 ± 0.04	18.70
GP	86.31 ± 0.42	0.37 ± 0.04	0.48 ± 0.005	0.028 ± 0.01	12.80

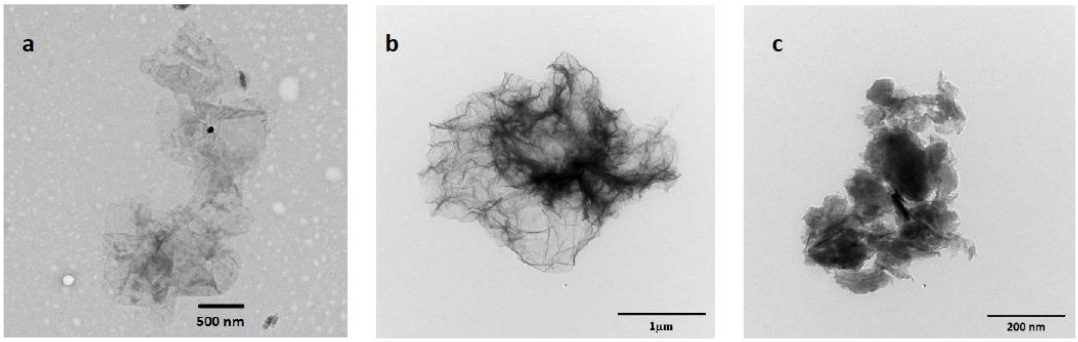

Figure S1. Representative TEM images of a) GO, b) rGO and c) GP nanomaterials.

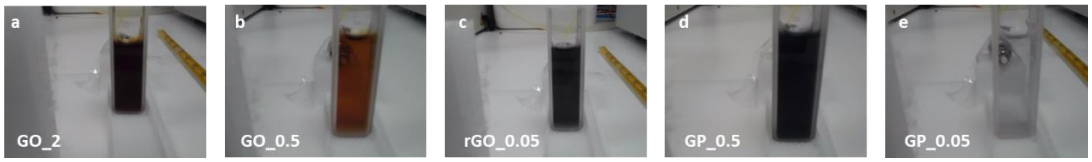

Figure S2. Digital pictures of a) GO_2, b) GO_0.5, c) rGO_0.05, d) GP_0.5 and e) GP_0.05 dispersions.

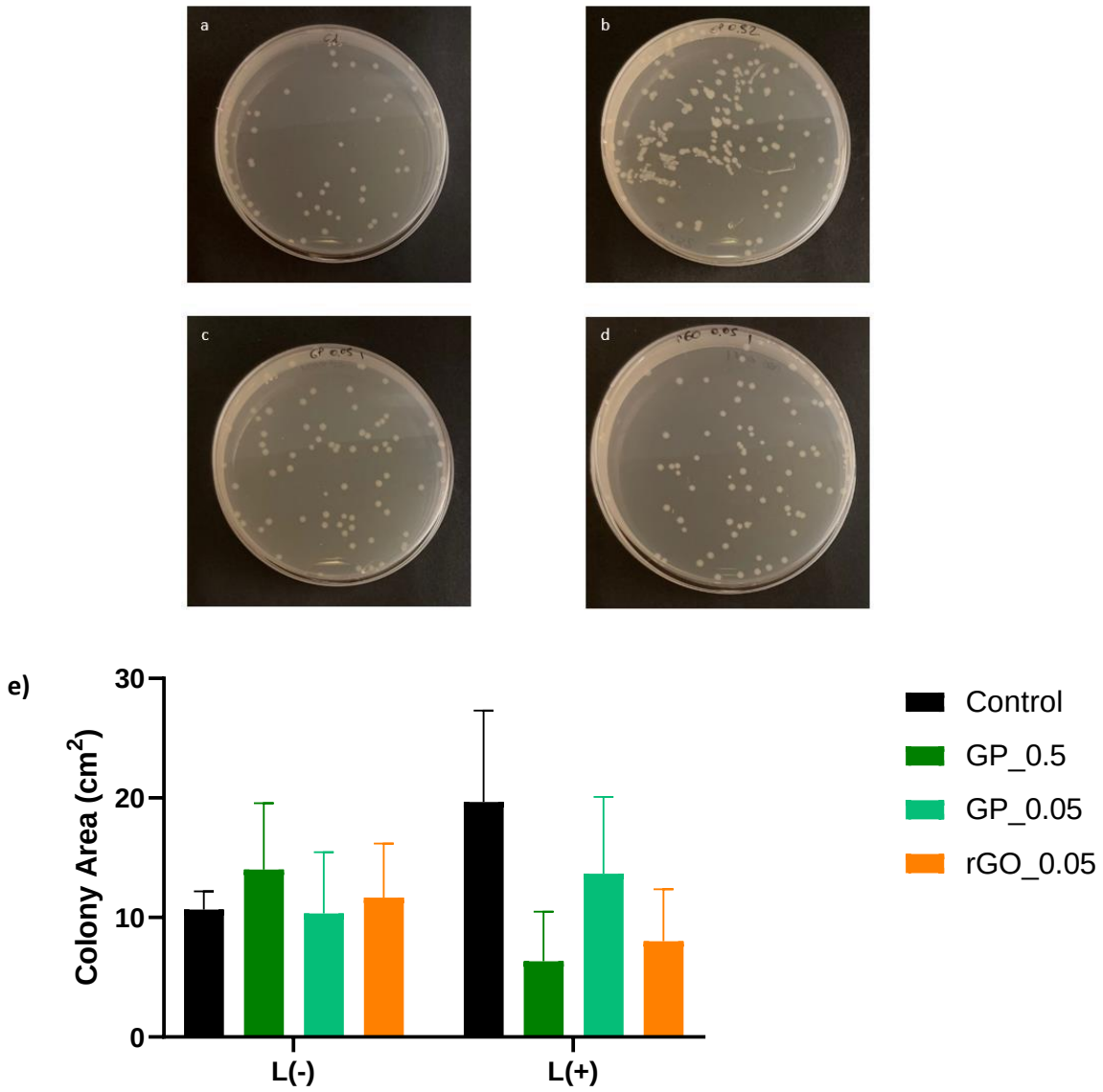

Figure S3. *E. coli* colonies formed after 24 h of incubation in presence of unirradiated samples. a) Control, b) GP_0.5, c) GP_0.05 and d) rGO_0.05. e) Bacterial viability quantified as the area of *E. coli* (%) grown on culture plates of unirradiated, L(-), and irradiated L(+) samples.

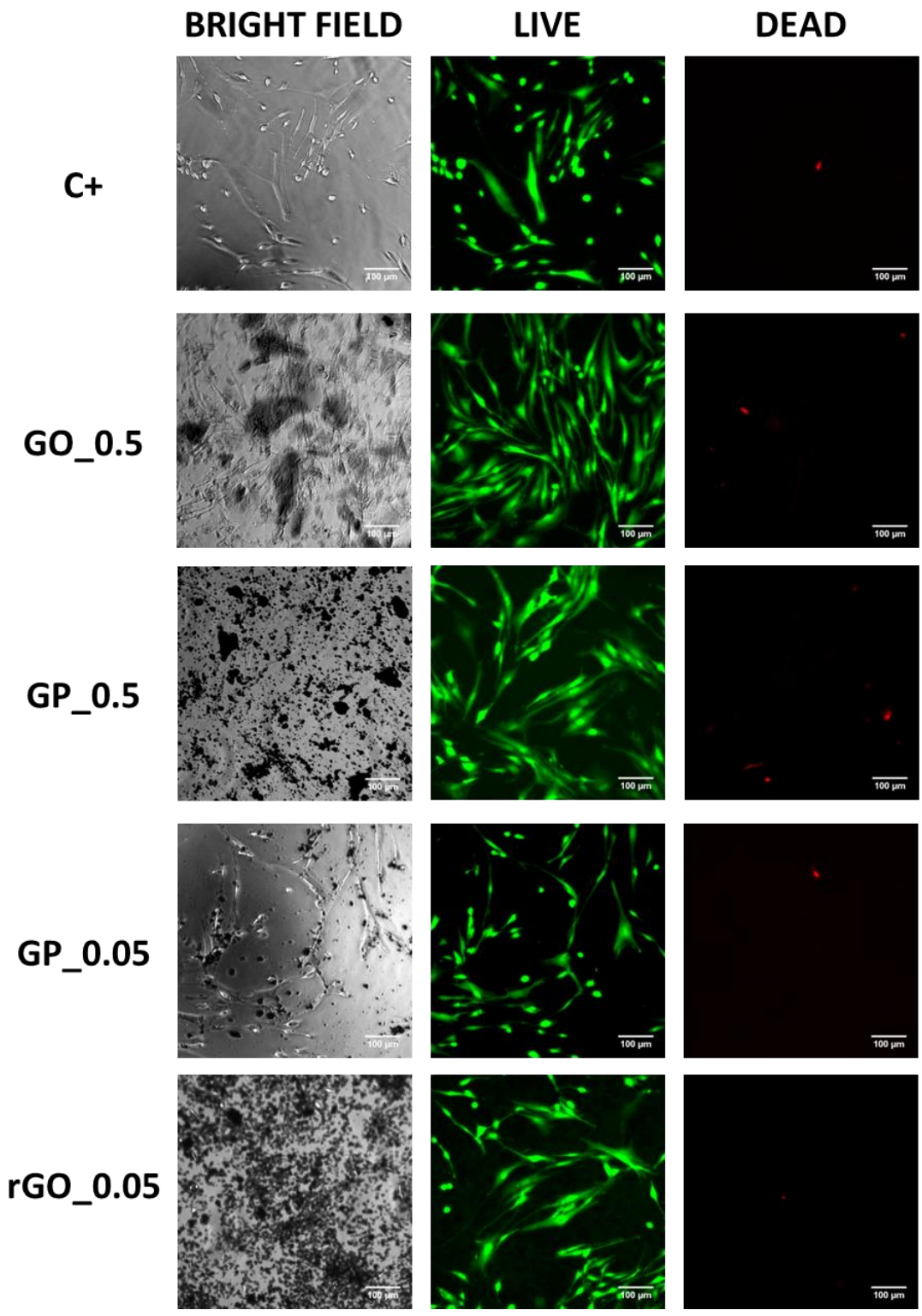

Figure S4. Live/Dead analysis, after exposure to the GBMs at different concentrations. Scale bars: 100 µm.

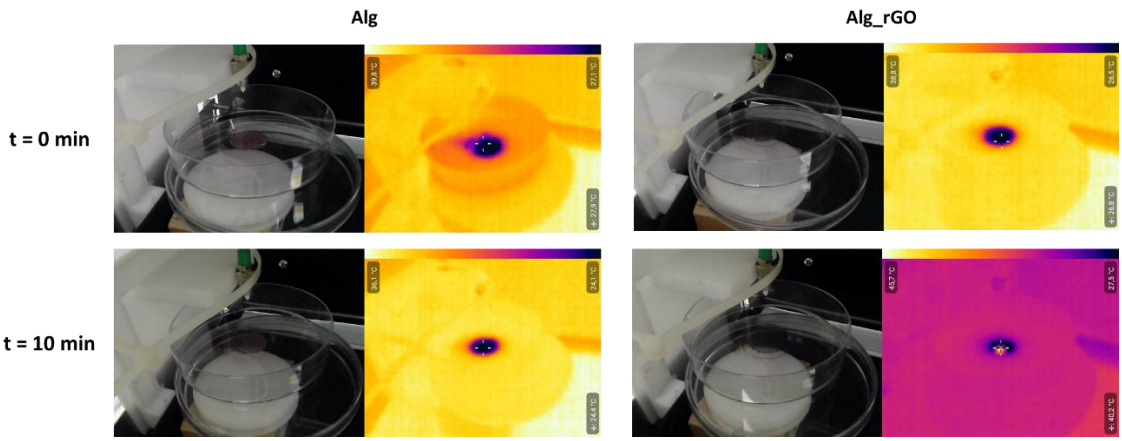

Figure S5. Representative images of bioprinted scaffolds Alg (left panel) and Alg_rGO (right panel) before irradiation (top panel) and after irradiation with 808 nm light for 10 min at a power density of 0.5 W/cm^2 (bottom panel).

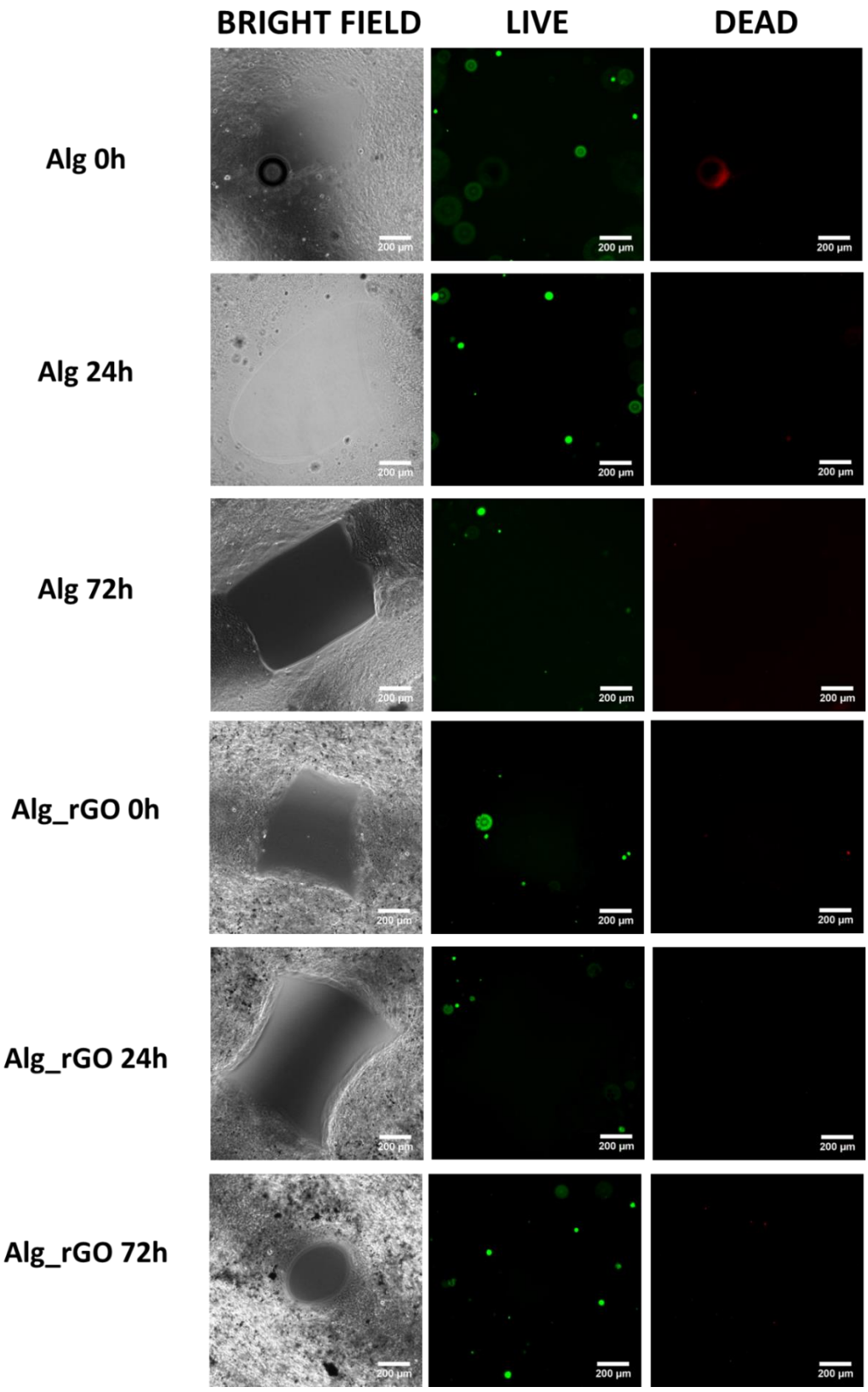

Figure S6. Representative pictures from the Live/Dead experiments of hFBs embedded into non-irradiated Alg and Alg_rGO hydrogels, at incubation time points of 0 h, 24 h and 72 h.

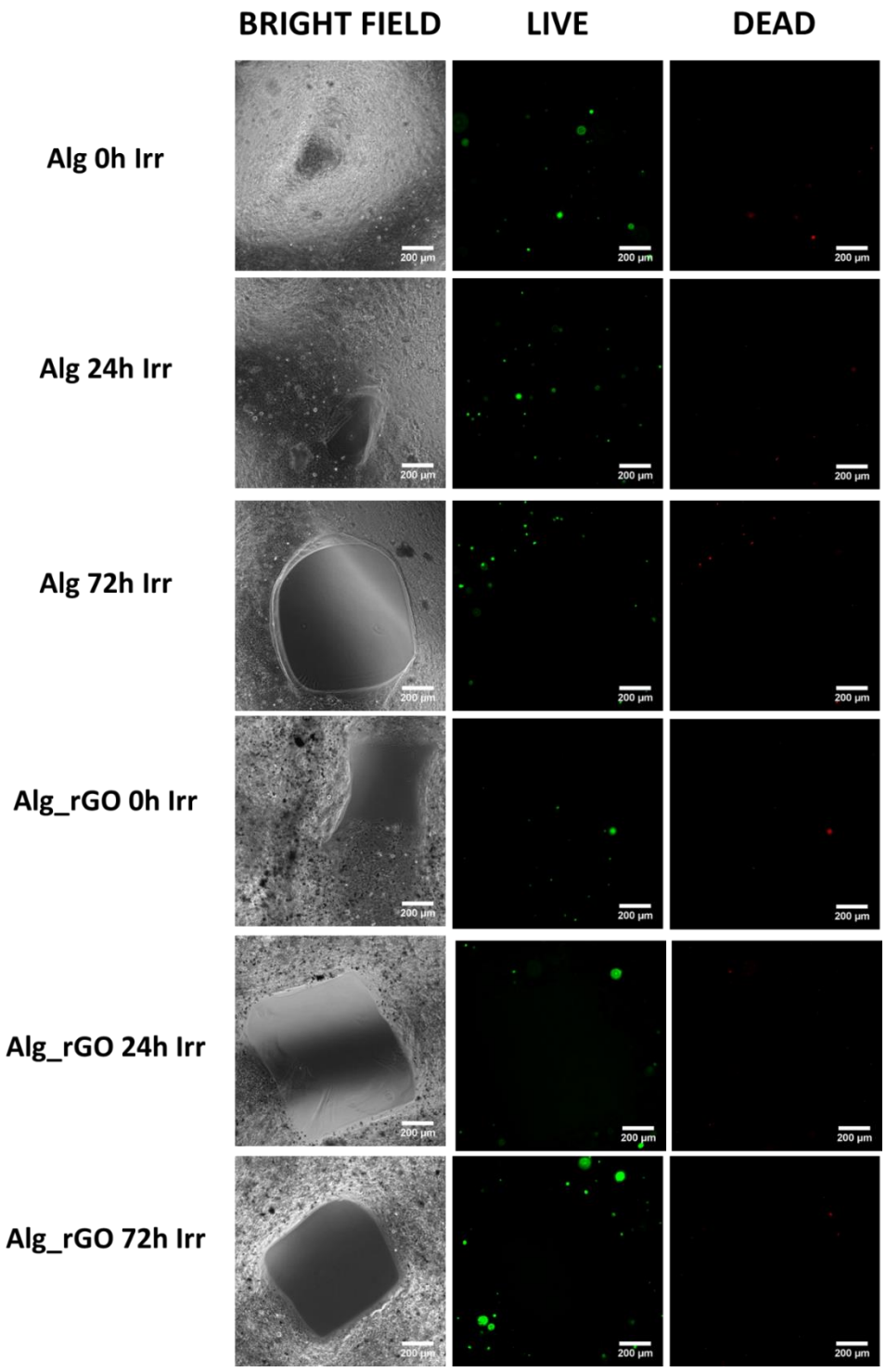

Figure S7. Representative pictures from the Live/Dead experiments of hFBs embedded into irradiated Alg and Alg_rGO hydrogels, at incubation time points of 0 h, 24 h and 72 h.