Supporting information

Experimental details

- Fabrication of shape-controlled PEG microgels

The PEG pre-polymer solution was produced by dissolving 0.5% (w/w) photoinitiator (Irgacure 2959; Ciba) and 20% (w/w) of poly(ethylene glycol) 1000 dimethacrylate (Polysciences Inc) in Dulbecco's Phosphate Buffered Saline 1X (Gibco). To mix the contents, the solution was stirred at 80ºC for 30min. To initiate the partial cross-linking of the gels prior to cell addition, the pre-polymer was illuminated with UVA (360-480 nm; 12.5 mW/cm^2) for 3s prior to use. To produce the microgel building blocks, 0.1ml of pre-polymer was placed in between a PDMS substrate and a negative photo-mask (the latter produced with a high resolution (i.e. 20000dpi) printer). The space between the surface and the mask, i.e. the thickness of the pre-polymer layer, was varied by the use of 150μm glass spacers. This setup was illuminated through the mask for 12s to crosslink the areas exposed to light. The non-crosslinked pre-polymer was then washed away, giving rise to a set of freestanding cube shape units. The intermediate crosslinking step was introduced to minimize the time that biological samples are under the action of free radicals. To produce the Nile red (Sigma, 318.37Da) labeled sub-units, the pre-polymer was mixed with the stain at a 0.2mM concentration prior to the UVA exposure.

- PDMS template fabrication and surface treatment

PDMS (Sylgard 184) was purchased from Dow Corning (Dow Corning Co., USA) and prepared in a 10:1 (base:cross-linker ratio) as per the manufacturer's specifications. The geometry of the PDMS surface was produced by molding.

To modify the surface of the PDMS it was oxidized in an air-plasma cleaner (Harrick plasma, USA, PDC-001) for 30s. To enhance the effect of the air plasma the PDMS was extracted in a series of solvents designed to remove unreacted oligomers from the bulk phase *[8]*. Specifically, the PDMS template was sequentially immersed during 2 hours in trietylamine, ethylacetate and acetone before being dried and oxidized in air plasma during 30 seconds to generate a stable layer of hydrophilic SiO_2 groups.

- Template based micro-masonry process

The building blocks were merged with the pre-polymer at a concentration of about 3000 units/ml (for the of 500μm sized-blocks) and deposited on the PDMS surface. The liquid/units wet the surface, which was gently agitated or aided with a needle to enhance the surface coverage and avoid the formation of aggregates. The few defects formed by groups of units were specifically removed by slightly pressing them against the surface. To direct the assembly and compaction at the surface, the prepolymer was removed by a pipette or an absorbent material (e.g. tissue paper), which ensured that only the pre-polymer entrapped between the units remained. A second UV treatment of 5s strengthened the structure which was then separated from the PDMS by hand.

For the fabrication of the tube with complementary sub-units (Figure 4C and D) an oxidized PDMS surface (i.e. hydrophilic) was wetted with the pre-polymer and the sub-units were deposited one by one in the proximity of a complementary sub-unit. The minimization of the capillary force drove each sub-unit to close contact with the adjacent sub-units. The process is repeated until the whole tube was formed. Then the tubular structure on the PDMS mold was set together by 5 seconds under UVA which cross-links

the pre-polymer between the sub-units. The tube was separated by hand from the PDMS surface, a process that can be helped by the hydration of the scaffold in PBS, which increases its size and loosens the contact with the mold surface.

In the case of multilayered tubes (Figure 4E and F) a tube, made of PEG units, was employed instead of the PDMS as surface guide. A new set of Nile red labeled sub-units in pre-polymer was deposited on the surface of the tube and the excess of polymer removed. The entire structure was then exposed to UV light for 5 seconds to stabilize the structure.

- Fabrication and assembly of cell-laden microgels

Hepatocarcinoma liver cells (HepG2 cells) were cultured in DMEM supplemented with 10% FBS and 1% Penicillin-Streptomycin in an incubator at 37°C and a 5% CO_2 atmosphere. After tripsinization, cells were suspended in the (pre-crosslinked) polymer solution at a concentration of 10^5 cells/ml. After merging the cells and the photocurable polymer, the process to produce the cell-laden units continues as described above. After the formation of the 3D scaffolds, cell viability was studied by incubating the construct in a live/dead assay (2µl Calcein/0.5µl EthD-1; Molecular Probes) in 1 ml of DPBS for 45 min then washing them in PBS three times. Living cells were labeled green while dead cells were labeled red.

We introduced a pre-crosslinking step in the process to reduce the time cells were exposed to UVA light. The liquid was pre-polymer irradiated with UVA for a short time (~3s) before being merged with the cells. The polymer was then mixed with the cells and fully cross-linked in a usual photolithography process with a negative mask. With this simple

change in approach we have been able to reduce to one third the time that cells are exposed to UVA.