Electronic Supplementary Material (ESI) for Biomaterials Science

Structural Reinforcement of Cell-Laden Hydrogels with Microfabricated Three Dimensional Scaffolds

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Supporting Information

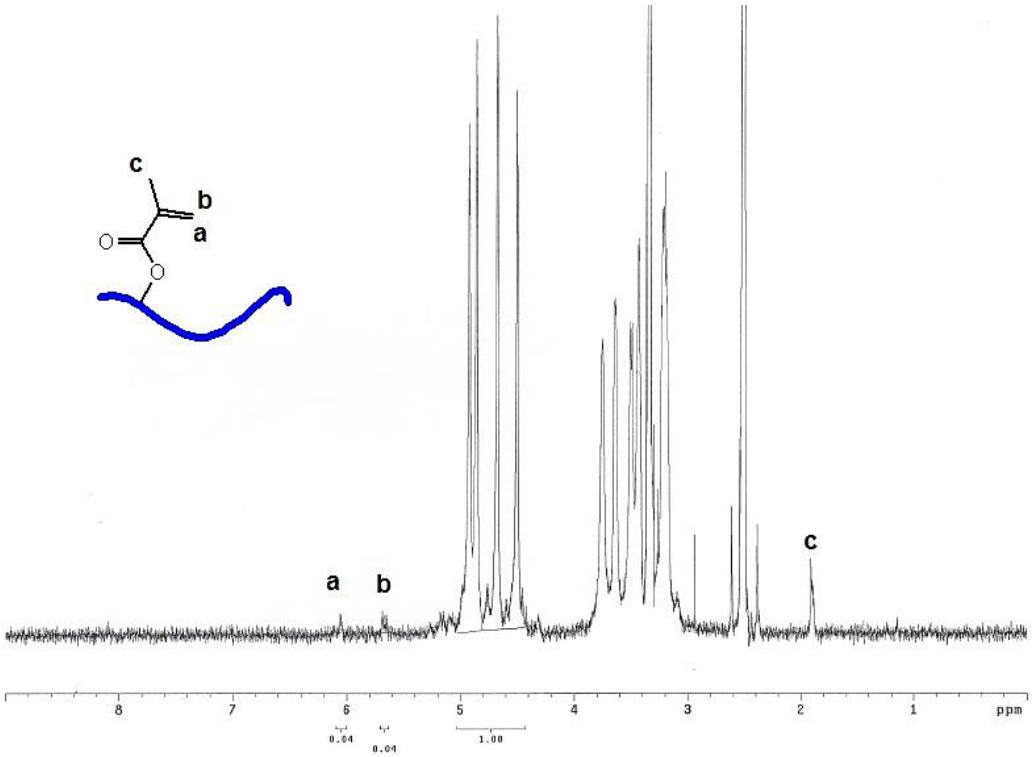


Fig. 1. ^{1}H-NMR spectrum of GelMA. Characteristic peaks of methacrylate are noted (**a** to **c**).

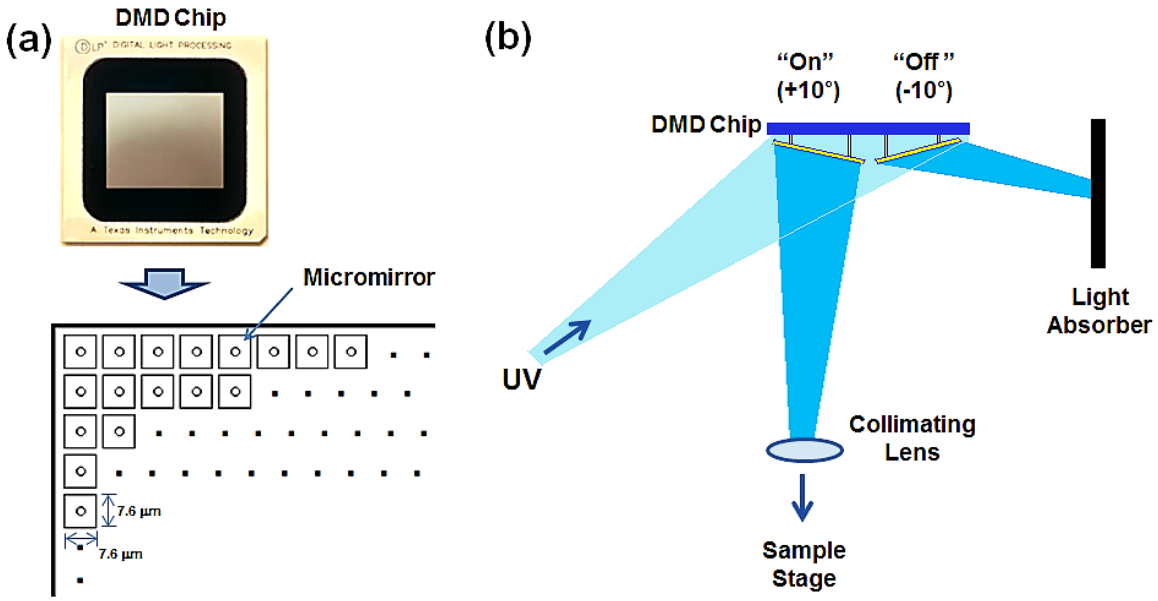


Fig. 2. (a) Schematic illustration of Digital Micromirror Device (DMD) chip. The DMD chip contains arrays of micromirrors (7.6 µm × 7.6 µm). (b) Each micromirror on the DMD chip can have "on" or "off" position by tilting the micromirror +10° or -10°. Only the "on" micromirrors reflect the UV light to the sample stage for material fabrication (+10°), whereas the "off" micromirrors reflect the UV light to light absorber (-10°).

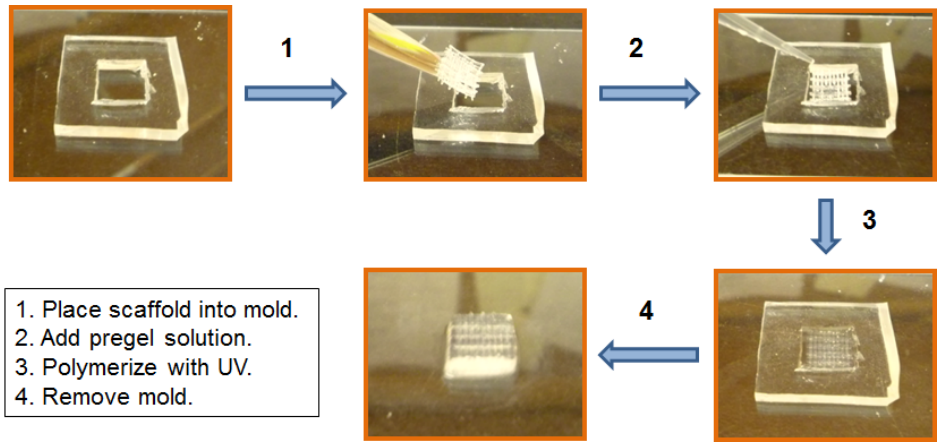


Fig. 3. Experimental procedure to fabricate scaffold-reinforced hydrogels.

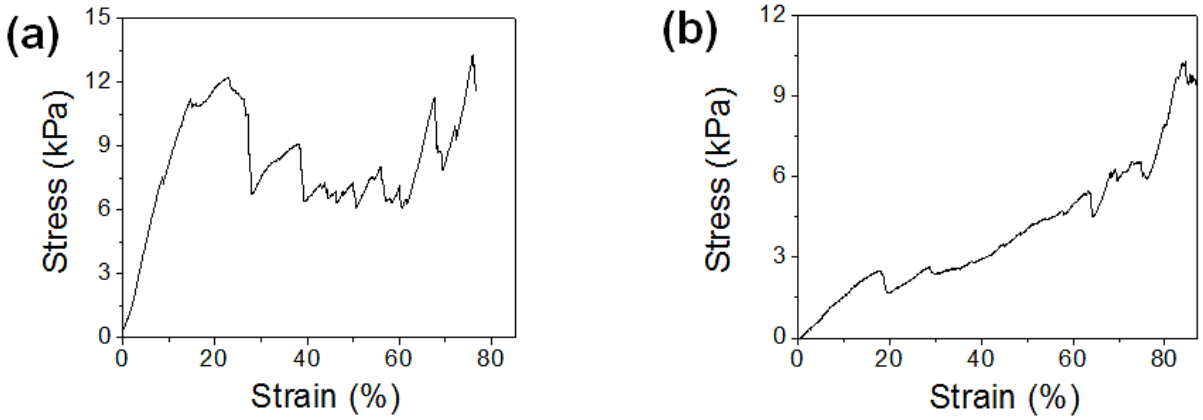


Fig. 4. Stress-strain curve of the PEGDA scaffolds made with (a) 50 wt% PEGDA and (b) 20 wt% PEGDA.

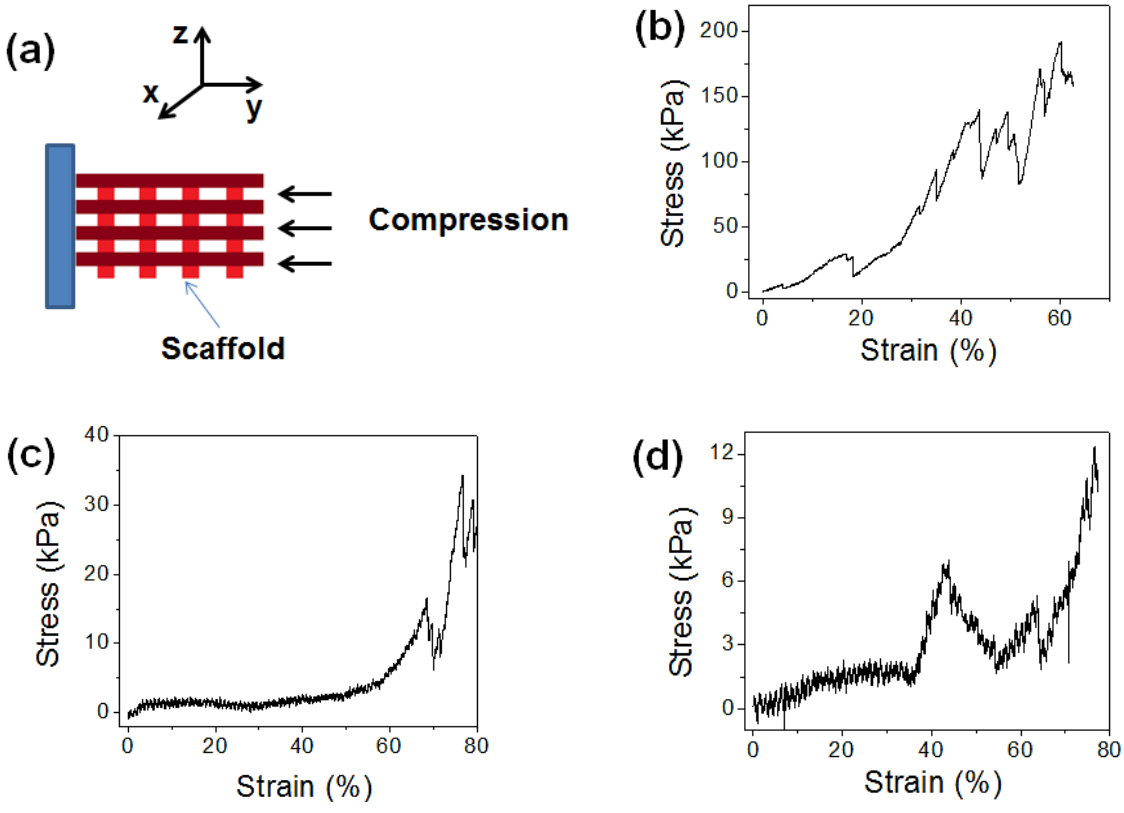
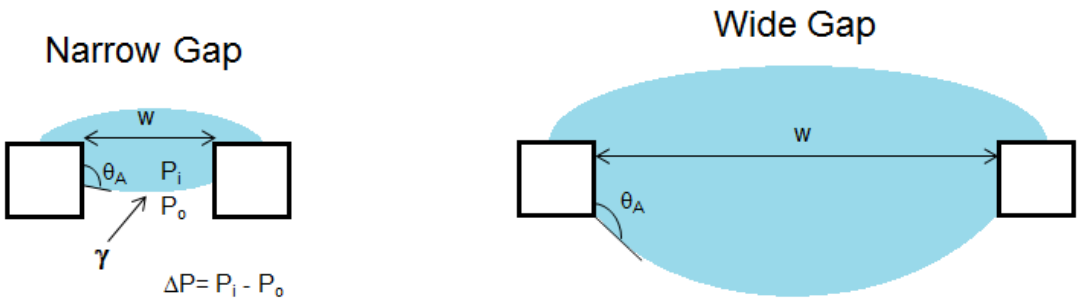


Fig. 5. (a) Mechanical properties of PEGDA scaffold was obtained via uniaxial compression in y-direction (long axis). Stress-strain curves of the microfabricated scaffold made from (b) 100% PEGDA, (c) 50% PEGDA and (d) 20% PEGDA.



Young-Laplace equation: $\Delta P = P_i - P_o = -4\gamma \frac{\cos\theta_A}{w}$

Fig. 6. Pre-gel solution penetrating into the PEGDA scaffold is described by a capillary burst valve injection model. In this model, the liquid can enter through a space driven by the pressure difference (ΔP) between the liquid (P_i) and the air (P_o), overcoming the surface tension (γ) and capillary force of the liquid. The relationship between ΔP, γ, advancing contact angle of the liquid to the wall (θ_A), and the gap between two bars (w) is given by the Young-Laplace equation. If w is wide enough, θ_A and the resulting ΔP are above critical values that can overcome γ and the liquid can enter the space. On the other hand, the liquid cannot enter freely into the space if w is too small that θ_A and the resulting ΔP are below the critical values.

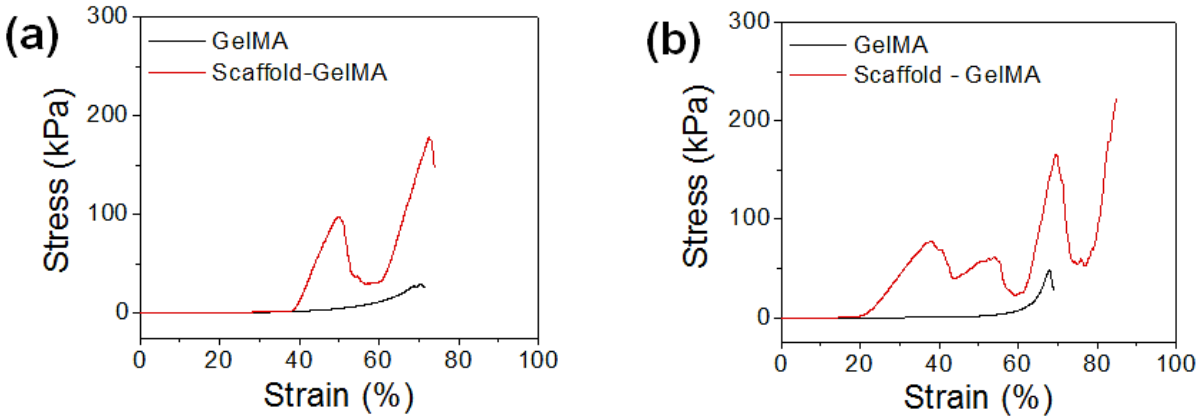


Fig. 7. Stress-strain curves of GelMA hydrogel and scaffold-reinforced GelMA hydrogel obtained from uniaxial compression. The scaffold was made from 100 wt% PEGDA. (a) 5 wt% GelMA, (b) 8 wt% GelMA.

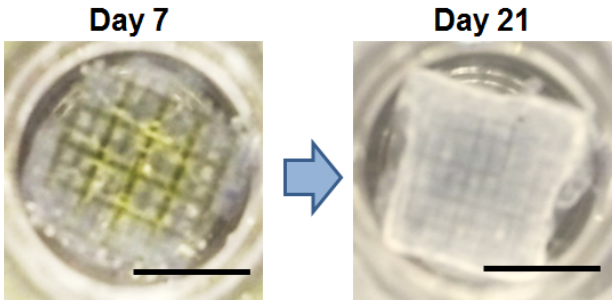


Fig. 8. A macroscopic view of scaffold-GelMA hydrogels encapsulated with 3T3 fibroblasts, cultured for 21 days. The cells proliferated extensively, resulting in a translucent construct.

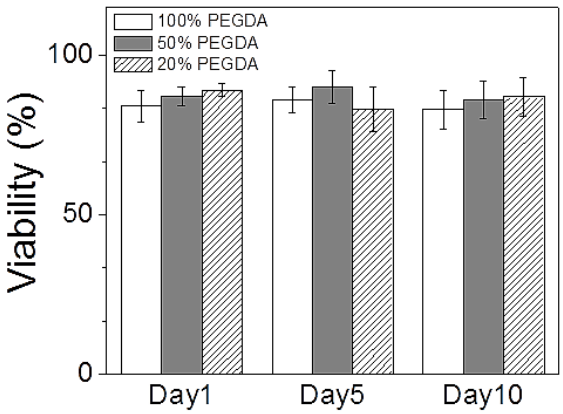


Fig. 9. Viability of 3T3 fibroblasts encapsulated in GelMA hydrogels reinforced with varying strengths of the PEGDA scaffolds (prepared with 20, 50, 100 wt% PEGDA), measured at days 1, 5, and 10.