

ADVANCED HEALTHCARE MATERIALS

Supporting Information

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Collagen Hydrogel Containing Polyethylenimine-Gold Nanoparticles for Drug Release and Enhanced Beating Properties of Engineered Cardiac Tissues

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Supplementary figures

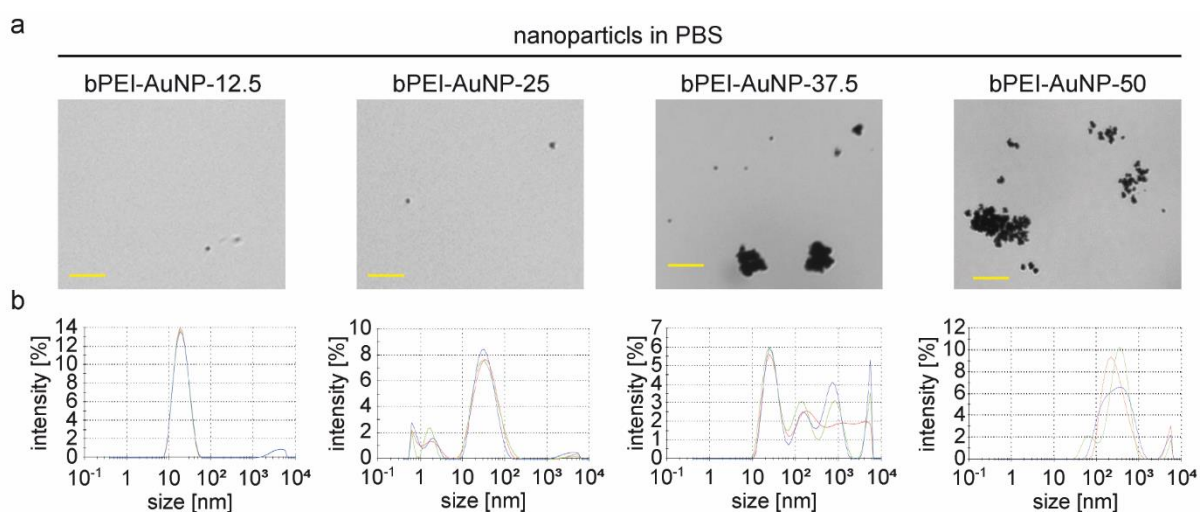


Figure S1. bPEI-AuNPs suspension in PBS. a) Representative phase contrast microscopic images of bPEI-AuNPs showing aggregate formation in bPEI-AuNP-37.5 and 50. b) Size distribution graphs of each nanoparticle solution measured by dynamic light scattering analysis. Scale bar: 5 μm .

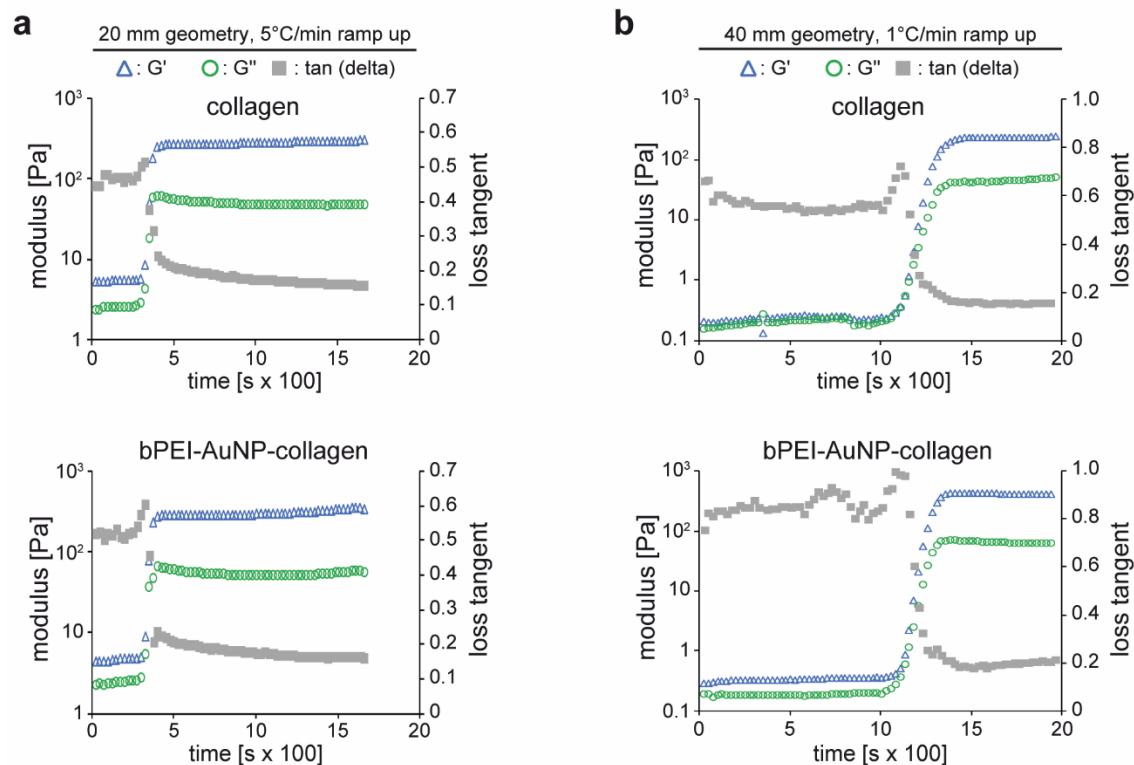


Figure S2. Time sweep analysis at low temperatures showing lag phase, growth phase and plateau regions. a) Representative time sweep diagram of hydrogels measured by 20 mm geometry with initial temperature set to 4°C and ramped up to 37°C at 5°C/min. b) Representative time sweep diagram of hydrogels measured by 40 mm geometry with initial temperature set to 4°C and ramped up to 37°C at 1°C/min.

recovery of the hydrogels over consecutive strain

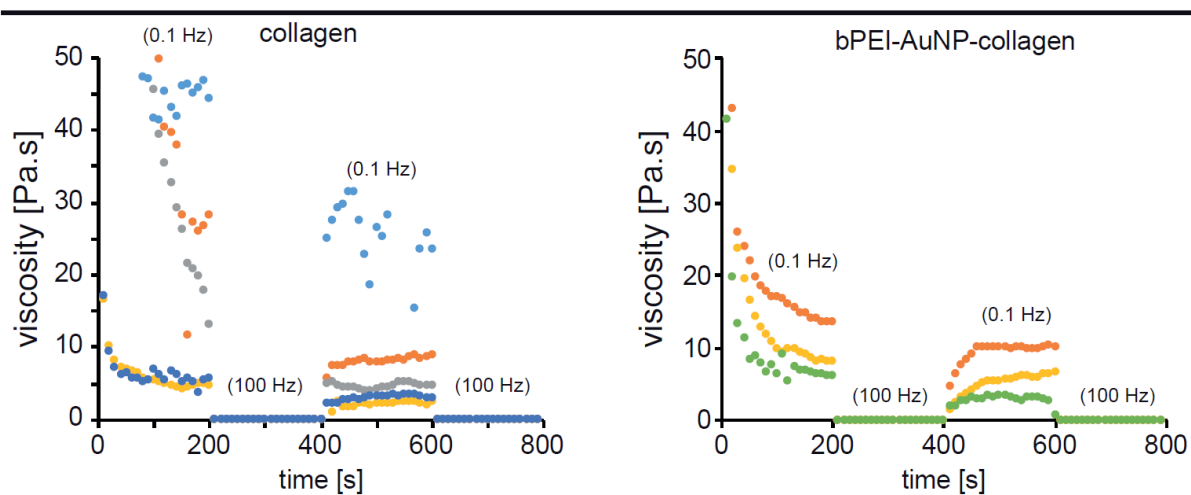


Figure S3. bPEI-AuNP-collagen hydrogels show slightly improved recovery characteristics over collagen hydrogels. Quantitative analysis of changes in viscosity over time as a function of angular frequency (indicated in parentheses). (collagen $n = 5$, bPEI-AuNP-collagen $n = 3$).

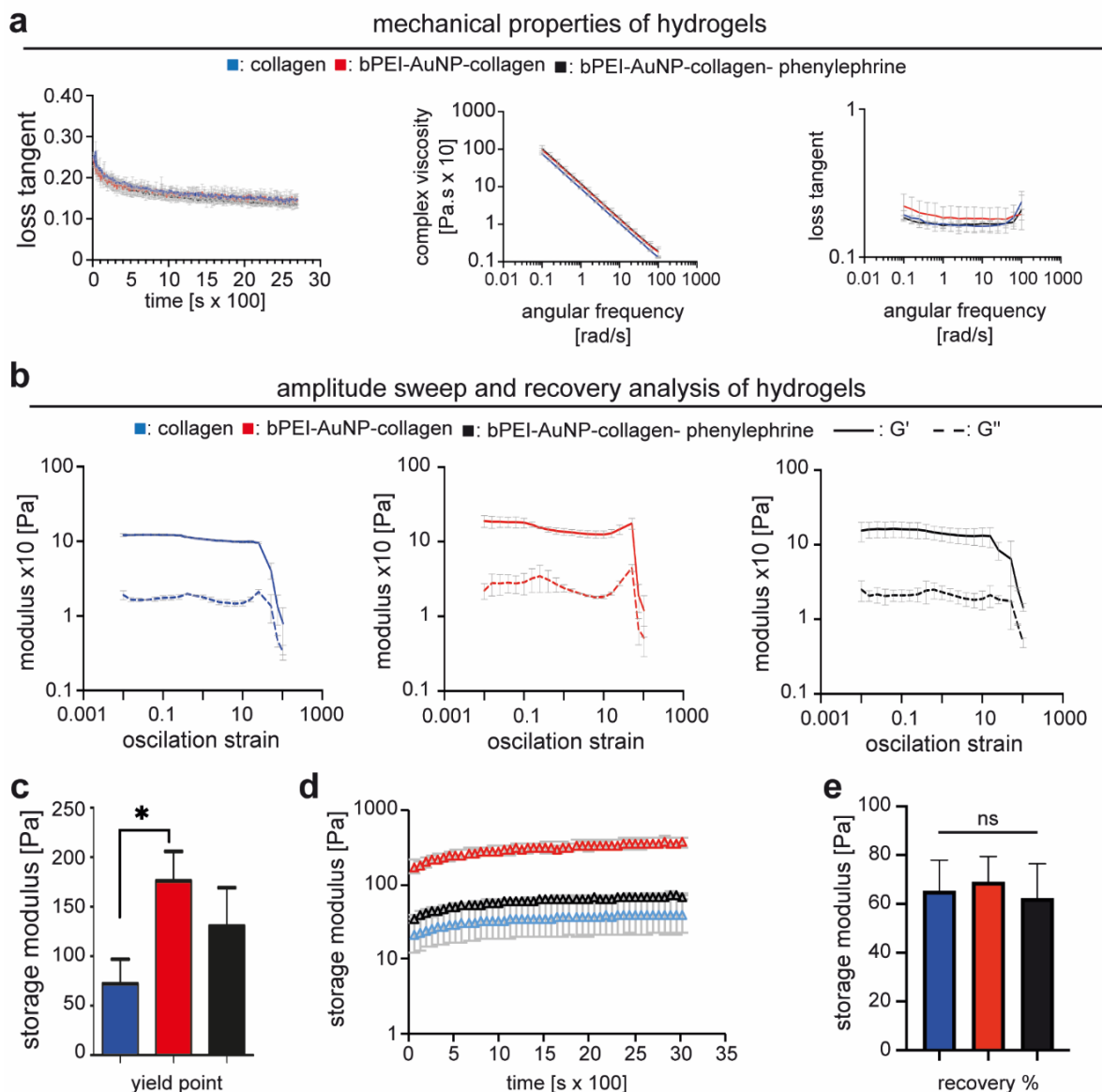


Figure S4. Rheological properties of collagen hydrogels, bPEI-AuNP-collagen, and bPEI-AuNP-collagen-phenylephrine hydrogels. a) Quantitative rheometric analysis of loss tangent over time of gelation, complex viscosity and loss tangent after gelation in a frequency sweep test ($n = 3$). b) Quantitative rheometric amplitude sweep analysis for 0.01 - 100% deformation ($n = 3$) and (c) determination of yield point. d) Analysis of hydrogel recovery after amplitude sweep test over time ($n = 3$) and (e) quantitative analysis of hydrogel recovery at the end of experiment ($n = 3$). Data are mean \pm SD.

Supplementary Table 1. Top 500 differentially expressed genes. For each of the top 500 differentially expressed genes between CAu and collagen groups visualized in the heatmap in Figure 8, the table shows: the Ensembl Gene Id, the corresponding HUGO gene symbol (whenever available), the complete output provided by DESeq2, i.e., its baseMean (average normalized expression values over all samples), log2FC (logarithm to the base 2 of the fold change), lcfSE (standard error estimate for the log2FC), stat (the value of the Wald statistic), pvalue (the p-value of Wald test) and padj (p-value adjusted for multiple testing).

Supplementary Table 2. Enriched pathways. The table lists the pathways (FDR < 0.01) belonging to the annotated clusters together with their associated p-value, FDR, regulation (up/down), and leading edge genes. For each cluster the AutoAnnotate label and the manually revised label are also provided.

Supplementary Table 3. Characterization of the genes belonging to the selected clusters. For each of the selected clusters, the table lists the number of unique genes (unique_genes), the number and percentage of the differentially expressed genes (sign_DE_genes), the number and percentage of genes available in the “RNA consensus tissue gene data” (unique_genes_found_consensus), the number and percentage of genes expressed in heart muscle (genes_heart_tissue), their associated nTPM distribution as median value and range, the number and percentage of differentially expressed genes expressed in heart tissue (sign_DE_genes_heart).

Supplementary Movie Captions

Supplementary movie 1: beating of hiPSC-derived cardiomyocytes at day 12

Supplementary movie 2: beating of hiPSC-derived cardiomyocytes at day 17

Supplementary movie 3: beating of hiPSC-derived cardiomyocytes at day 31

Supplementary movie 4: beating of hiPSC-derived cardiomyocytes at day 5

Supplementary movie 5: calcium handling of hiPSC-derived cardiomyocytes at day 22

Supplementary movie 6: beating of hiPSC-derived cardiomyocytes within phenylephrine-loaded bPEI-AuNP-collagen hydrogels at days 2, 3, 7, and 14.

Supplementary movie 7: beating of hiPSC-derived cardiomyocytes within collagen-phenylephrine hydrogels at days 2, 3, 7, and 14.