Supplemental Material for "DNA-caged Nanoparticles via Electrostatic Self-Assembly"

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Supplementary Methods

Characterization of micelle nanocomposite size, encapsulation efficiency, and polydispersity

To determine the morphology and size of the polymer nanoparticles, we used transmission electron microscopy (TEM). TEM grids were treated using a PELCO easiGlow™ Glow Discharge Cleaning System prior to nanoparticle deposition. Then, a 12.5 µL sample droplet was pipetted onto a silicone pad over which the TEM grid was inverted for 5 minutes. Excess sample was then slowly wicked away using filter paper. Negative staining was performed using 1% uranyl acetate dissolved in distilled water. TEM images were collected using an FEI Tecnai G2 Bio Twin TEM at 80kV.

Encapsulation efficiency was measured using ultraviolet-visible (UV-Vis, GENESYS 6, Thermo-Fisher) measured against a standard curve. Coumarin-6 micelles were isolated using centrifugal filtration (regenerated cellulose 30 kDa NMWL Amicon Ultra-15, Millipore Sigma cat. no. UFC903024) at 4000 rpm for 15 minutes with 3 washes using DI water. Then, collected samples were imaged in UV-Vis and compared to the signal for the coumarin-6 containing initial solution. The ratio of these two signals provides the encapsulation efficiency.

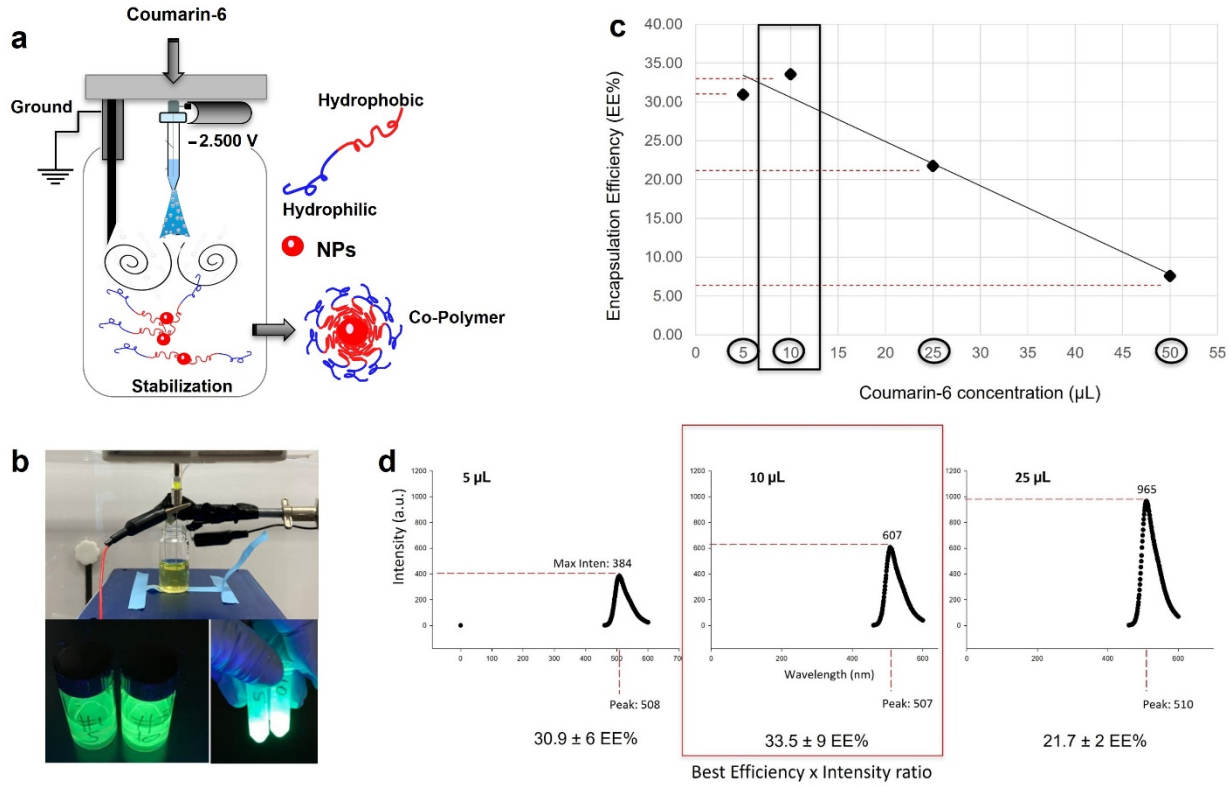
Supplementary Table 1. DNA tile sequences

G1-sticky-handle	AAAAATTTCGACGTTACATGCACCTCGCTCGAGCCAGTGAGGACGGAAGTTTGTCGTAG CATCGCACC
G2-sticky-handle	AAAAATTTCGACGTTACATGCACCTCGCTCGAGC CAACCACGCCTGTCCA TT ACTTCCGTCCTCACTG
G3-sticky-handle	AAAAATTTCGACGTTACATGCACCTCGCTCGAGC GGTGCGATGCTACGAC TT TGGACAGGCGTGGTTG
9 bp compliment	TAAATTGAGGATTATCAAACATGTAACG/3Cy5Sp/
12 bp compliment	ATTGAGGATTATCAAAGAGGTGCATGTA
15 bp compliment	GATTATCAAAGAGGTGCATGTAACG/3Cy5Sp/
26 bp (full) compliment	GAGGTGCATGTAACGTCGAAATTTTT
Slide	GATTATCAAAGAGGTGCATGTAACGTCG/3ThioMC3-D/
Antibody	/5Cy5/GATTATCAAAGAGGTGCATGTAACGTCG/3AmMO/

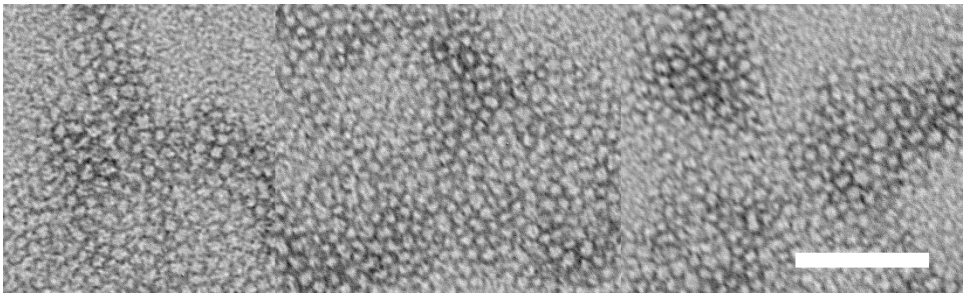
Supplementary Table 2. Aggregation verification by dynamic light scattering

Particle Type	Before Caging (nm)	After Caging (nm)
PS Beads	29.5 ± 0.9	94.8 ± 18.8
SPIONs	52.4 ± 3.4	52.5 ± 1.0
AuNPs	N/A*	N/A*

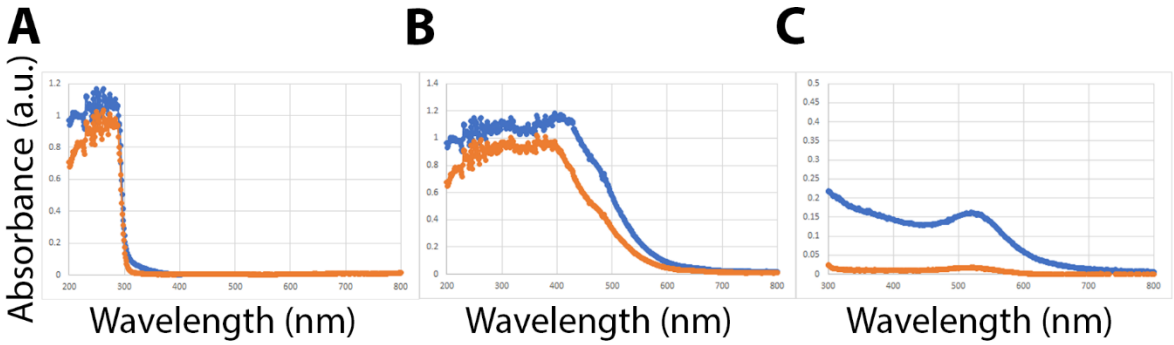
*AuNPs were too small to observe via DLS. See Supplementary Figure 3 for aggregation analysis via absorbance



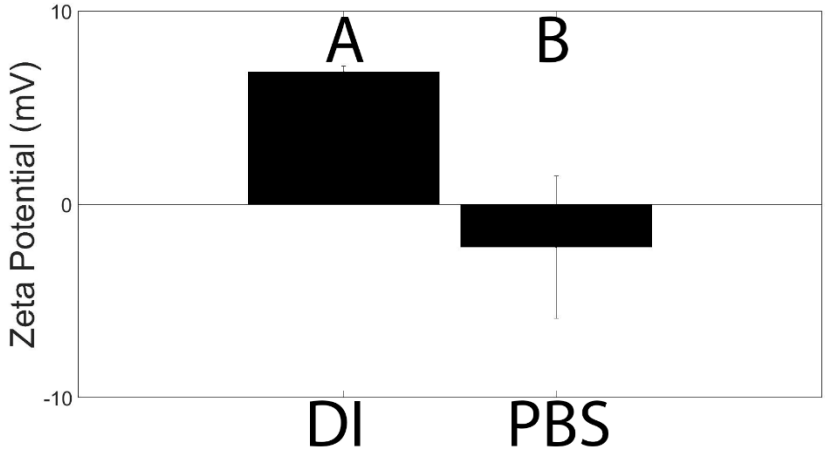
Supplementary Figure 1: (a) Schematic of the electrohydrodynamic mixing high voltage nanoprecipitation of amphiphilic DSPE-PEG polymers loaded with fluorescent coumarin-6 dye (C6). (b) (Top) Actual set-up and (bottom) example coumarin-6 micelles (bottom, left) before and (bottom, right) after purification. (c) Coumarin-6 UV-Vis calibration curve showing linear range. (d) Encapsulation efficiencies of coumarin-6 micelles with different amounts of coumarin-6 added. Optimal encapsulatio efficiency occured at 10 µL.



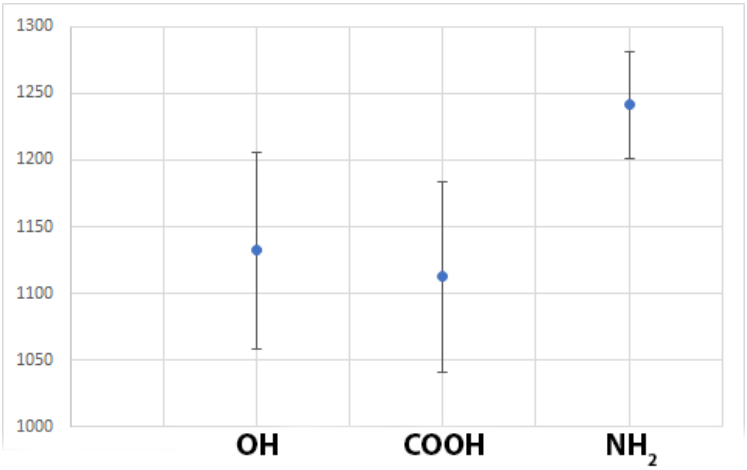
Supplementary Figure 2. TEM images of coumarin-6 micelles. Scale bar = 100 nm.



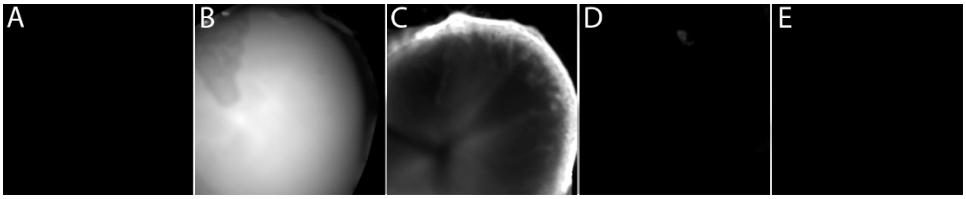
Supplementary Figure 3. DNA-caged nanoparticle stability and aggregation before (blue) and after (orange) caging verified by UV-visible absorbance of A) PS beads, B) SPIONs, and C) AuNPs.



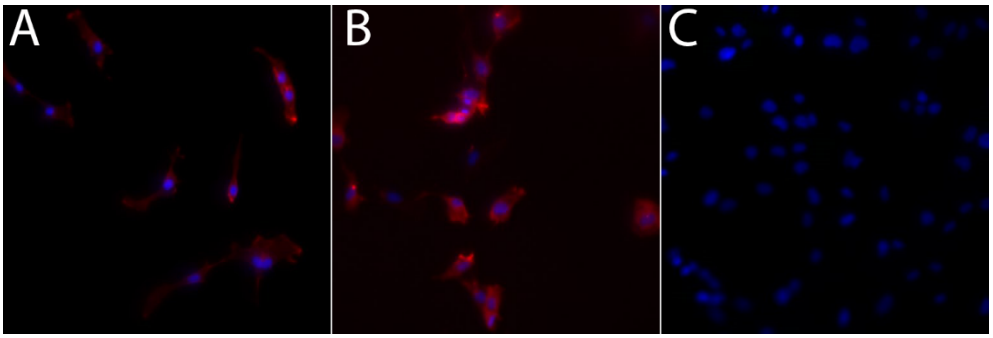
Supplementary Figure 4. Change in zeta potential of 50% NH_2 DSPE-PEG micelles in pH 7 DI and PBS.



Supplementary Figure 5. Electrostatic adsorption of DNA tiles modified with FAM-6 to 20 nm polystyrene (PS) beads with different surface modifications at DNA: nanoparticle molar ratio of 48 x 10^3.



Supplementary Figure 6. Fluorescent microscope images of DNA caged nanoparticles on slides: A) PBS blank before DNA-caged nanoparticle addition, B) after addition of a droplet of DNA-caged nanoparticles, C) DNA-caged nanoparticle signal following droplet removal and washing with PBS three times (attached), D) residual DNA-caged nanoparticle signal after strand displacement and washing with PBS three times (erased), and E) non-specific attachment of DNA cages to slides without ssDNA binding targets.



Supplementary Figure 7. Fluorescent microscope images of cell labeling controls: A) Cells labeled with primary antibodies and Alexa Fluor 568 secondary antibodies, B) Cells labeled with ssDNA primary antibodies and Alexa Fluor 568 secondary antibodies, and C) Negative control with no primary antibodies and DNA caged nanoparticles added.