SUPPORTING INFORMATION

Evaluating Heterogeneous Binding Avidities of Populations of Ligand-Functionalized Multivalent Nanoparticles

Ming-Hsin Li,[1,2] Seok Ki Choi,[2,3] Pascale R. Leroueil,[2,3] and James R. Baker, Jr.[1,2,3]*

1. Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI 48109, USA

2. Michigan Nanotechnology Institute for Medicine and Biological Sciences, University of Michigan, Ann Arbor, MI 48109, USA

3. Department of Internal Medicine, University of Michigan, Ann Arbor, MI 48109, USA

E-mail: jbakerjr@med.umich.edu

Figure S1. Potentiometric titration of G5 PAMAM dendrimers with surface acylation shows that approximately 80% of the surface is converted from amines to acyl groups (G5-Ac_{80}-NH_2).

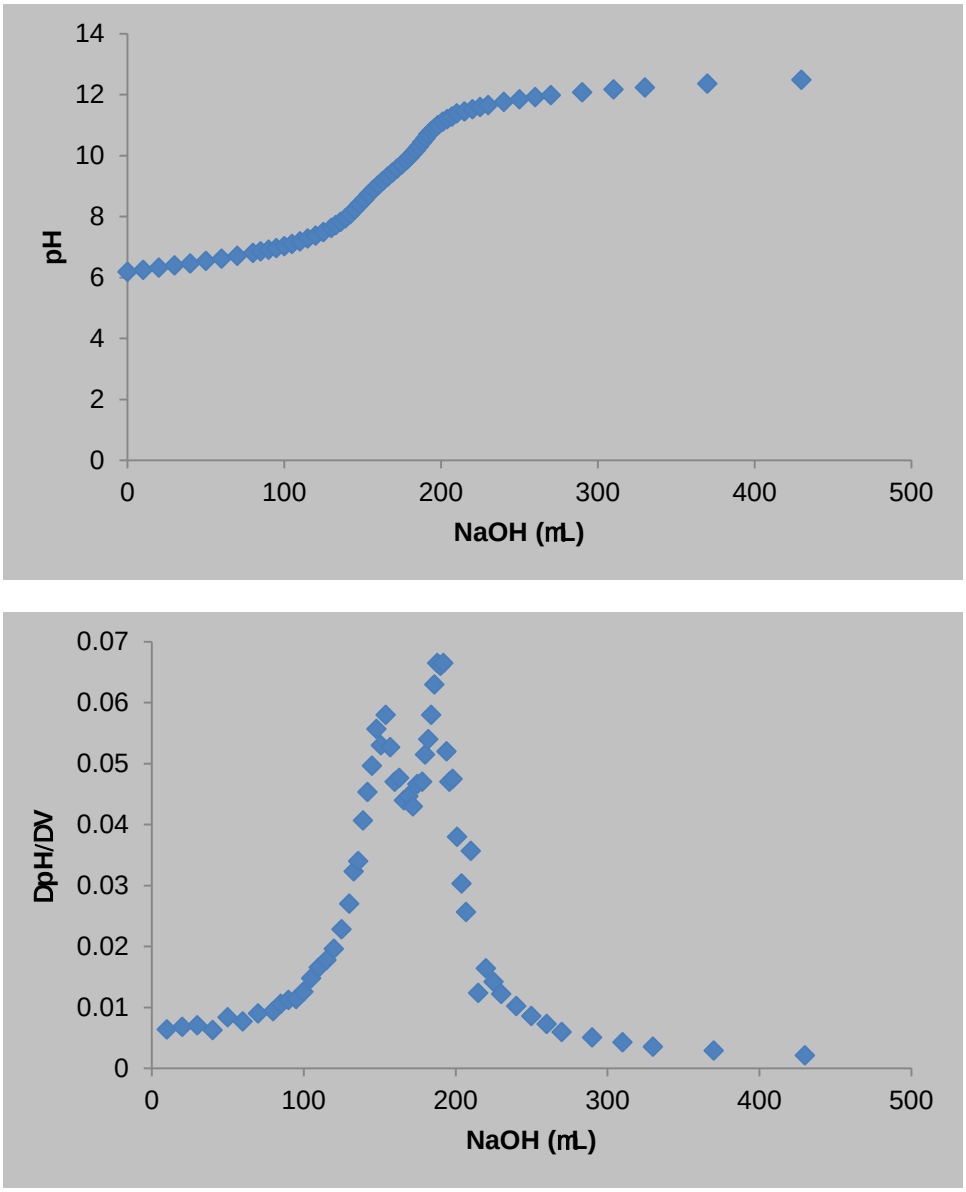
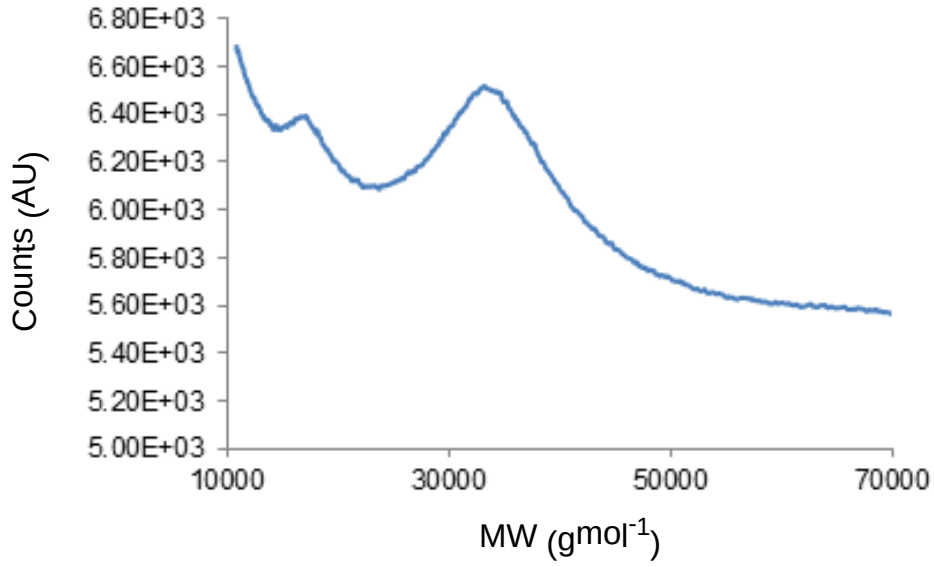


Figure S2. MALDI-TOF MS spectra of (a) G5-$(oligo)_6$ (MW= 34500) (b) G5-$(oligo)_{3.1}$ (MW= 32200) (c) G5-$(oligo)_{1.7}$ (MW = 32400).

(a)



(b)

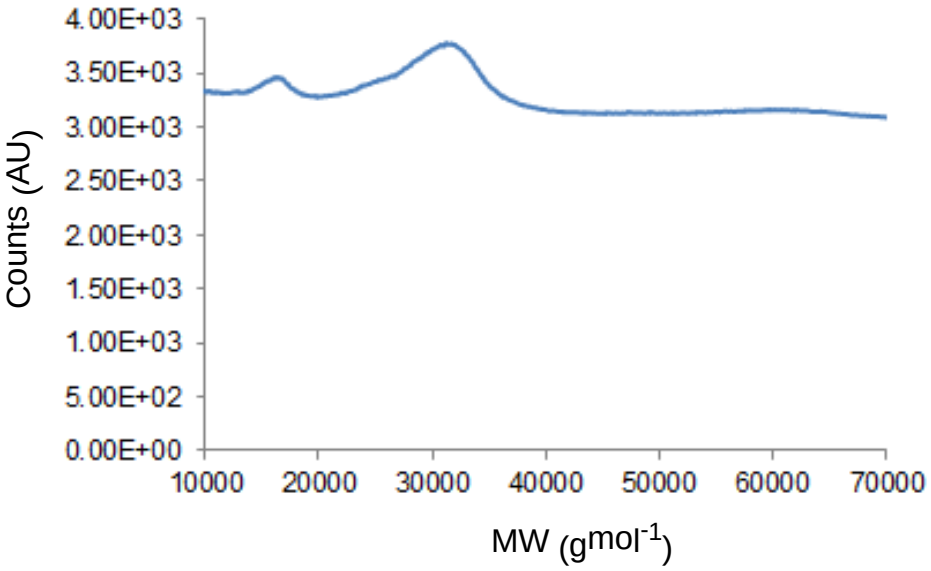


Figure S3. UV-Vis spectra of G5-$(oligo)_6$ (blue); G5-$(oligo)_{3.1}$ (red) (G5-$oligo)_{1.7}$ (green), measured at 0.05 mg/mL. Peak at absorption max of DNA (260 nM) clearly shows difference in the number of oligonucleotides per dendrimer.

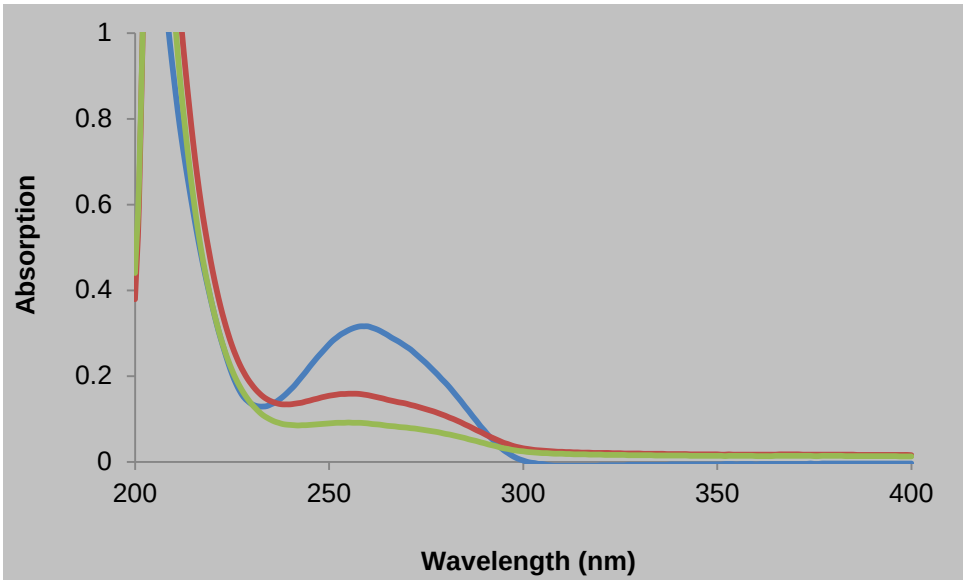
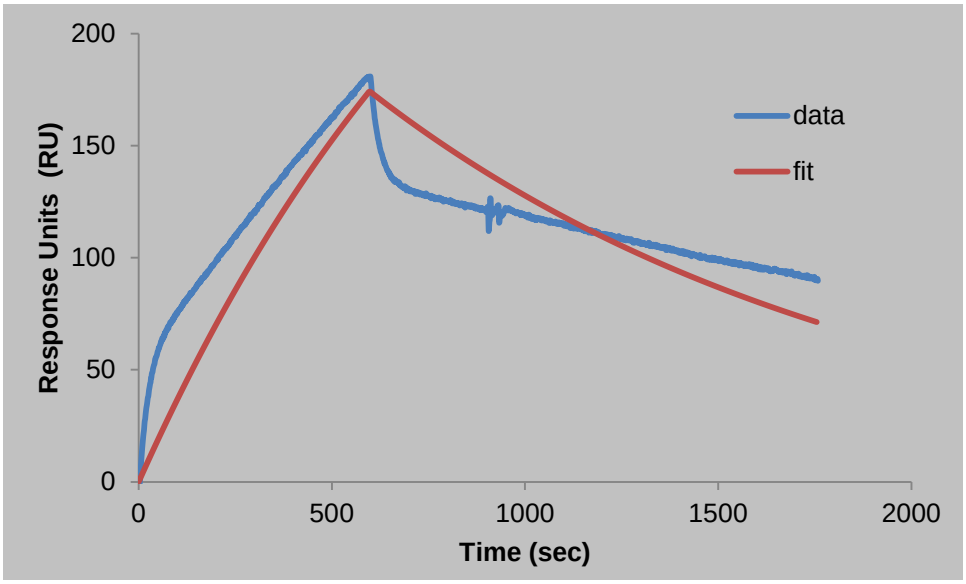


Figure S4. Binding curve of G5-$(oligo)_6$ and a representative fit of the curve data using a 1:1 Langmuir model. The concentration of G5-$(oligo)_6$ was 62.5 nM. (c^2 = 369)



Initial rate analysis coupled with SPR analysis

Ligand-receptor interactions are typically described with 1:1 Langmuir kinetic model (shown as Equation. 1, below). In this equation, A and B are the ligand and receptor, where k_{on}, and k_{off} represent the association and dissociation rate constants of the interaction. The ratio of these constants, K_D, the dissociation rate constant, has units of concentration and is conventionally used as an indicator of binding strength. Kinetic data from optical biosensor analyses can be described as a first-order differential equation (Equation 2) and its integrated form can be employed to fit kinetic parameters. (shown in Equation 3) In this analysis R represents the response unit (RU) from the sensor surface at the time of measurement, R_{max} is the maximum RU of the receptor-covered surface and C is the concentration of the ligand. Equation 4 is derived by the differentiation of Equation 3 with respect to time (t), At t=0, Equation 4 can be simplified to yield Equation 5. These transformations document that the initial slope of the RU (at t=0) is positively associated with the concentration of the ligand because in this situation R_{max} and C are constants.

Equation 1

$$(A + B) \underset{k_{off}}{\overset{k_{on}}{\rightleftharpoons}} A\text{-}B$$

Equation 2

$$\frac{dR}{dt} = R_{max} * k_{on} * (R_{max} - R) - k_{off} * R$$

Equation 3

$$R = \frac{R_{max} * C}{k_{on} * C + k_{off}} * (1 - e^{(-k_{on} * C + k_{off})t})$$

Equation 4

$$\frac{dR}{dt} = \frac{R_{max} * C}{K_D + C} * (k_{on} * C + k_{off}) * e^{(-k_{on} * C + k_{off})t})$$

Equation 5

$$\frac{dR}{dt}|_0 = R_{max} * k_{on} * C$$