Dynamics of Viral Nanoparticles as Reporters in Lateral Flow Essays

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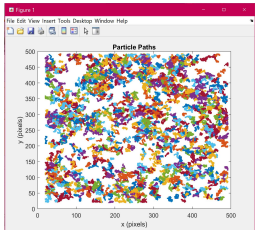
Background

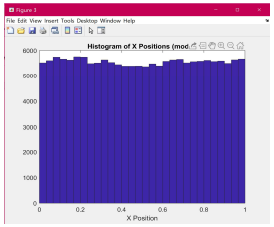
Later Flow Assay's are useful for various reasons yet have some defects. LFA's are a device that target specific substances in liquid samples. There are disadvantages such as lacking sensitivity due to the volume of samples. These tests are used in clinical diagnostics, environmental tests, and food safety inspections and etc. Because these diagnostic test are simplistic and cheap to perform for professionals, LFA's and their efficiency should be optimized. LFA's are being optimized in research labs by looking at the dynamics of phage particles in bulk solutions along with the viscosity of solutions.

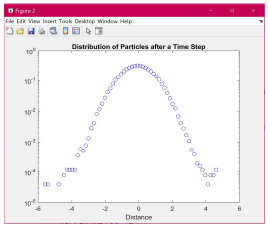
The movement of viral nanoparticles in polymer solutions applied in Lateral Flow Assay's (LFA's) will be analyzed. Reporter particles and their diffusivity are quantified in model solutions.

Analysis and Result

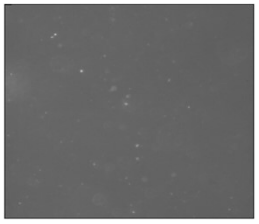
- Particle full-tracking was done in MATLAB. The results showed us the particle paths, histogram of varying x positions (striving for a flat histogram for little variation), and normal distribution of particles in a graph (to measure the distribution of particles in a time step, a normal distribution would indicate gaussian distribution.

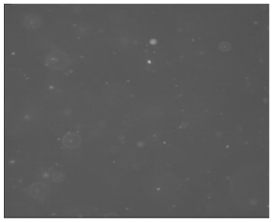


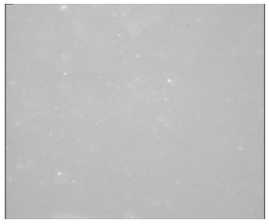




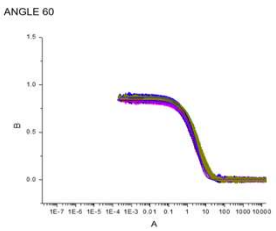
- Tracking chamber analyzed under a miscroscope show whether phage would survive in IPA or Methanol. Survival occurred in IPA due to the fact that we could see the phages in the video images.







- We used Dynamic Light Scattering Machine (DLS) to measure the hydrodynamic radius as a scattering experiment at different angles using the DLS Cumulant function, along with OriginPro and Excel. The Tau values we would be averaged in MS Excel to measure the diffusivity according to the Stokes-Einstein Equation.



Tau			
Value	Standard Error	95% LCL	95% UCL
7.44371	0.15208	7.14537	7.74205
6.35245	0.1326	6.09234	6.61257
7.50895	0.15109	7.21256	7.80534
6.56646	0.13979	6.29223	6.84069
6.66255	0.13924	6.3894	6.9357
7.2979	0.15199	6.99974	7.59607
8.64026	0.17615	8.29471	8.98582
1	--	1	1

Approach / Methods

- M13 Phages were dyed with Alexa555 dye.
- flow coater films made using a solution containing M13phage in 2wt% phage in IPA
- We analyzed samples under a microscope to see if phages survived in IPA or methanol by placing them in cover slips
- The films made on glass substrate would be seen under the microscope and videos would be taken in order to track their diffusivity in MATLAB
- films of varying thickness were made by varying the speed with the flow coater device
- The thickness of films were measured in silicone wafers under the Filmetrics device
- We measured the intrinsic viscosity by timing the intervals in which the solution used rose and fell with a viscometer
- We got the radius of gyration using the overlap concentration formula in which

$$c^* = Mw / (4/3) (pi) (Rg^3) (Na)$$

Conclusions

Due to the fact that it was hard to see the phages under the microscope in the flow samples, we are varying the amount of H2O used until we make a perfectly uniform film under the same speed. If this is not a factor, we will proceed to add more phage above a concentration of 2microL in order to see the phage fully under the microscope. After that the membranes of the LFA will be functionalized. I will carry out experiments regarding particles and how they bind to membranes. In addition, the particle virus transport in membranes will be studied by their diffusion and flow.

Acknowledgement

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