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Pressure Sensitive Microdroplet Formation

Fluorescence fluctuation spectroscopy (FFS) is a single molecule technique that provides information about size, concentration, transport processes, and composition of protein complexes. The protein of interest is labeled with a fluorescent tag that acts as a lightbulb and produces a short burst of light when passing through a small optical observation volume. Statistical analysis of these bursts determines the size and composition of the sample. A recent application of FFS determined the copy number of proteins carried by a viral-like particle (VLP).The results of this study put into question the currently assumed assembly model. However, FFS only reports average size and copy number of a population, which is a weakness of the current study, because VLPs are known to be heterogeneous in size. In order to directly test the assembly model we need to perform FFS measurements on single viral particles or alternatively on single cells. We plan to accomplish this task by encapsulating individual VLPs or cells in nanoliter-sized aqueous droplets produced by a microdroplet generator. My project specifically is to characterize and optimize the droplet formation process in microfluidic devices. I am analyzing the influence of different types of solutions on the droplet formation process. I will also study the effect of flow speed on droplet size and frequency. The goal of my study is to identify the optimal conditions for droplet formation for the future FFS experiments on VLPs.

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