Humberto Sanchez
July 18 2023
900am
ChemBE
NAH 149

DEVELOPMENT AND OPTIMIZATION OF DROP-BASEDMICROFLUIDIC DEVICES AND PERIPHERY EQUIPMENT

Drop-based microfluidics is used to encapsulate small volumes of biological agents into discrete drops. The contents of these pico-liter sized drops can then be used for biochemical assays. Microfluidic devices are used to manipulate these drops through the removal and addition of drop contents. While pumps are used to control the fluid flow within the microfluidic devices. Often, the pumps used to drive fluid flow are prohibitively costly and the fluid dynamics of the devices used to control drop contents are not fully described. This research focuses on de-mystifying both the pump systems and microfluidic devices commonly used in drop-based microfluidics. We focused on developing an open-source pneumatic pressure pump to create microfluidic drops. Pneumatic pressure pumps have been found to be flexible and accurate systems to control fluid flow within microfluidic devices. Our pump system was found to be accurate and fast-responding as well as easy to assemble and control via open-source software. In addition, we developed a design process to develop drop-based split-and-merge (SAM) microfluidic devices. These devices have been commonly used to control drop volumes and add reagents for intra-drop assays. Our design and optimization methodology was then used to develop multiple SAM geometries with various splitting capabilities and the ability to create a broad range of drop volumes. The operating conditions for each SAM device was optimized for different input drop volumes. We also developed an empirical and novel drop model to predict drop volume changes within a SAM device.