Miniaturized Microfluidic Device for High Throughput Production of Lipid Nanoparticles

Team 25: **Shirin Bakre, Genevieve Dowd, Liam Murray, Michael Sisk**
Technical Advisors: **Douglas Densmore (BU ECE), Radhakrishna Sanka (ECE)**

Microfluidic devices are ideal for developing and manufacturing lipid nanoparticles for drug delivery because they allow the production of micro-scale products with limited waste. The primary restriction with these devices, however, is their output potential; microfluidic devices are often limited to production of small volumes of product. In order to counter these constraints, toroidal micromixer (TrM) and staggered herringbone micromixer (SHM) designs are investigated. To resolve which of the mixing methods is most efficient at high flow rates, mixing index (MI) is measured across colored water pushed through the mixers. After determining that the TrM is a suboptimal mixing mechanism in comparison to the traditional SHM, we have developed computational designs for the SHM in order to create this component through soft lithography. Using a chrome mask and custom manifold to produce an insert, this PDMS-based mixer was then inserted into a polycarbonate device containing a multiplexer and parallelization ladder. Multiplexion allows for the selection of inputs internally, enabling expedient switching between various inputs. The use of a parallelization ladder enables greater throughput by dividing the inputs between multiple mixers. As the mixer requires a comparatively low volume to function, mixing serves as a bottleneck. Parallelization via a ladder system allows individual mixers to receive appropriate volumes while a greater volume is processed by the device as a whole.