

The UVM Engineered Biomaterials Research Laboratory (EBRL) is developing a scaffold system for osteochondral tissue regeneration. Tissue growth will depend on the presence of biodegradable drug-encapsulating microspheres in the scaffold system. While the laboratory has a current method of creating microspheres, results are non-homogenous - a challenge in predicting the drug release profile from the microspheres for clinical applications. To control the drug release rate, the size of the microspheres must be controlled with high precision. My goal is to develop and optimize a microfluidic flow focusing device (MFFD) for the fabrication of monodisperse microspheres for drug delivery. A MFFD produces microspheres by combining a water-in-oil emulsion with a controlled flow rate, which allows the user to control the volumes of fluids, resulting in controllable microsphere dimensions. An MFFD has been developed through use of photolithography, polymer curing, and plasma treating. The optimization of the device will involve analyzing the size range of the microspheres through scanning electron microscopy (SEM). The use of the SEM imaging will serve two purposes; to investigate the consistency of microsphere size and provide additional data to correlate the relation between flow rate, viscosity, and the size of the microspheres. This data will be used to enable future members of the laboratory to fabricate microspheres with exact specifications based on the viscosity of their hydrogel solutions used in the creation of the microspheres. The microspheres could also provide a major breakthrough in the use of drug delivery and tissue engineering by having the extremely predictable and reproducible results that are needed to market and sell an item to the medical industry.