On Formation of Uniform Microspheres for Drug Delivery Using a Perforated Silicon Membrane: A Preliminary Study

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A novel method to generate uniform biodegradable microspheres for drug delivery applications has been developed. A liquid phase containing the dissolved microsphere matrix material reaches a continuous phase through a silicon membrane with micron-sized perforations, where it forms microdroplets. The solvent diffuses out of the droplets into the continuous phase leading to the formation of solid microspheres. Experiments with poly (lactic-co-glycolic acid) (PLGA) as the matrix material produced microspheres of which 95% had a diameter between 1 and 2 μm, a smaller size and a narrower size distribution than those reported elsewhere using glass or ceramic membranes. Such microspheres will be useful for the intravascular application and pharmaceutical drug delivery with a slow release of the drug at narrowly defined rates. Drug desorption and biodegradation rates induce controllable drug release from functionalized biodegradable microspheres. Those rates are directly proportional to microsphere size. One problem in conventional methods is how to achieve a desired average size and a narrow size distribution of the microspheres. Using a perforated silicon membrane, the size of the microdroplets mainly depends on the pore size and the speed of the continuous phase. By controlling these two parameters, it will be possible to fabricate monodisperse microspheres. The MEMS based approach to microsphere fabrication provided in this paper allows a better control over microsphere dimensions and therefore better control over drug delivery than those reported elsewhere.