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Development of A Microfluidic Method to Synthesize Metallic Nanoparticles

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Abstract

Microfluidic devices provide a simple and versatile method for generating micron size fluid drops at high rates. The monodispersity of these droplets allows for the development of microreactors and for the templating and formation of microparticles. Monodisperse droplets formed in microfluidic devices have been utilized in numerous applications including as templates for novel colloidal assemblies, as reactors for protein crystallization, and as components in lab-on-a-chip devices for DNA analysis and flow cytometry.

The hypothesis that drives this work is that regions of flow behavior in microfluidic devices can be optimized to generate droplets and particles that are nanometers in size rather than microns. These droplets (10-100nm in size) will be used as nanoreactors to form metal nanoparticles that will be even smaller (2-20nm). Observations made by Anna and co-workers indicate that the formation of nanometer-scale droplets in microfluidic devices is feasible. However, a lack of techniques to characterize these small particles in solution has hindered the growth of this powerful technique. This proposal has two main components: (1) to develop the flow focusing method to produce highly monodisperse nanodroplets with tailored dimensions and surface chemistry, and (2) to utilize these droplets as monodisperse nanoreactors for the generation of metal (gold or silver) nanoparticles. Neither of these would be possible without the small-angle x-ray scattering facility that will soon be established at Carnegie Mellon University.