MICROFLUIDIC PLATFORM FOR CONTINUOUS SYNTHESIS OF NANOPARTICLES

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Nanoparticles of various kind are used in numerous fields of Pharmaceutical and Biomedical Engineering thanks to their unique structural, chemical and physical properties. The common denominator for most high-end applications is the urgent need for nanoparticles with well-defined and uniform properties. For all these applications, particle nucleation and growth control play a significant role due to size and shape-depended properties. Traditionally the batch synthesis method is the most preferred way of nanoparticle preparation for its simplicity and low cost of instrumentation. However, in many instances, it is very challenging to control mixing, heat and mass transport, especially in the case of ultra-fast precipitation reactions and large- volume reaction mixture. This often leads to unwanted batch-to-batch variation in the quality of the product in terms of particle size and shape.

Therefore, better methods are necessary to satisfy annually increasing demands for particles having the monodisperse size and regular shape. Nanoparticle synthesis by microfluidic devices has become one of the most explored methods in the last few years. Microfluidic synthesis promises many advantages over batch synthesis. Firstly, a large surface area to volume ratio of microchannels helps to increase mass and heat transfer in the system. Secondly, it provides higher mixing efficiency using smaller reaction volumes than batch methods. Additionally, microfluidic devices are more suitable to work at harsh conditions in comparison to the batch reactors with regards to rapid temperature and pressure changes while using toxic and explosive materials.

In this work, the synthesis of silica, silver and magnetite nanoparticles will be discussed using the microfluidic platform. The goal was to compare a standard batch process with the continuous process using microfluidics of nanoparticle synthesis. The properties of synthesized nanoparticles, particle size and morphology, will be analyzed and discussed.