

Synthesis of nanoparticles in microfluidic devices based on the LTCC technology

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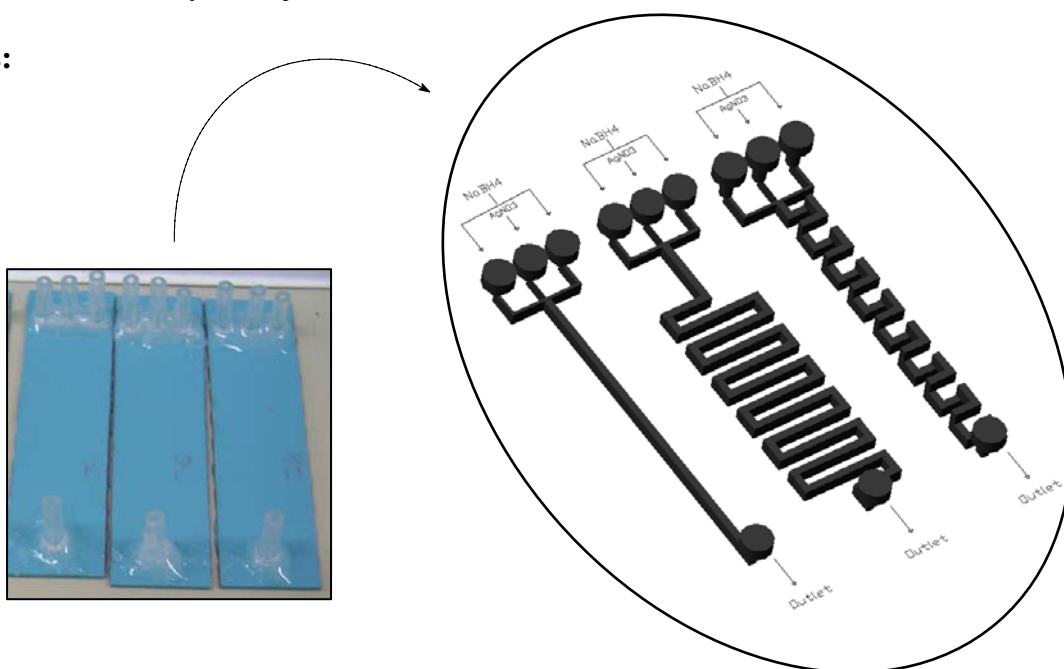
The synthesis and characterisation of nanoparticles (NPs) have been widely investigated in recent years due to their great variety of applications. Specifically, metallic NPs are great candidates owing to their tuneable optical and electronic properties. However, conventional synthetic methods are handicapped by the low production of NPs and by the difficulties of controlling their morphology, size distribution and crystalline properties, which makes very difficult achieving a good reproducibility. Some factors such as the injection process, local temperature and concentration fluctuations, rate of stirring and rate of cooling are difficult to control in batch processes but not in microfluidic flow reactors, where the reaction is confined in a small area and all the parameters can be defined.

Herein, we propose the use of ceramic microfluidic devices based on the LTCC (Low-Temperature Co-fired Ceramics) technology for the synthesis and functionalization of metallic NPs. These microfluidic reactors show some very interesting advantages regarding other existing ones, which make them a great alternative.

The LTCC technology enables the construction of multilayered systems, where can be integrated other mechanic, electronic and fluidic components. Moreover, the construction process of the designed prototypes is carried out in a simple and fast way without the need of sophisticated facilities, reducing significantly the cost and production time. The technique also allows the integration of multiple analytical paths in a single device without holding structural problems related to the lack of sealing between layers or components.

Green tape's properties allow working in a wide range of temperatures, while other materials cannot, by the introduction of resistor and thermistor systems inside the microfluidic platform. The manipulation of reagent droplets is controlled by the geometry and size of the channels and the flow rates. Furthermore, a good reagents mixing can be achieved by introducing passive or active mixers, so more uniform particles can be obtained. They also permit the addition of reagents when necessary and the modification of the composition of the reaction mixture is controlled by the injection volumes of each channel.

Figures:



Some of the designed and constructed structures for the metallic NPs synthesis in LTCC.