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C2-WED-PM5-5 - Femtosecond laser micromachining of microfluidic components in BK7 optical glass

C2. Laser-based Processing and Manufacturing

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Introduction/Purpose

The objective of this work was the development of micromachining with femtosecond laser in BK7 optical glass for the production of components of microfluidic devices. The aim was to produce microchannels, microvalves, micropumps, mixers and a localized heater, which can be arranged in any way to produce microfluidic devices on demand.

Methods

The structures were machined on the surface of BK7 glass plates, with the use of ultrashort laser pulses of a Ti:sapphire system on a high precision displacement stage and numerical control program. The first step was to obtain a set of process parameters suitable for efficient and accurate machining that would result in a smooth surface with no collateral damage to the neighboring region.

Results

Microvalves were machined with these optimized parameters, and when powered by pneumatic drive and managed by a dedicated software presented a flow control of less than 1 nl/s. These microvalves were used together to produce micrpumps to control flows in regions where external pressure can not be achieved.

Mixers are also being developed for single phase systems and for biphasic systems. A machine vision system is being used to characterize both systems. Color analysis for single phase mixers and bubble analysis for biphasic ones.

An innovative localized heating system was developed for temperature control in microreactors. For this, a tiny metal blade was textured with fs laser where light absorptive nanostructures were obtained. The slide was introduced into a microreator that had its temperature controlled through the focusing of an external source of light on its surface. With this, it was possible to control temperature above 100°C inside the microreator.

Conclusions

With the developed components, some microfluidic systems were built. In particular, a system for synthesis of NaYF4 nanocrystals and for ELISA assays will be presented.

Selected references

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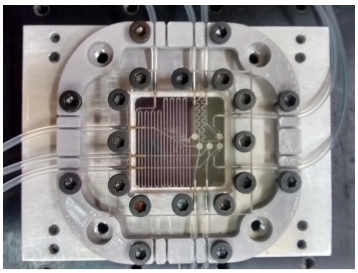

Microfluidic device for nanocrystals growth