

# High-pressure chemistry in ultra small pressure cooker

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Small, clever process technology is essential for the future, but is it possible? Dutch-sponsored researcher Fernando Benito López investigated the possibilities of the so-called lab-on-a-chip: microreactor chips in which chemical reactions can take place under (high) pressure. The results were very promising. The reaction rate increased compared to conventional equipment, the measurements were accurate and safety was not a problem. Moreover it was possible to follow and regulate the reaction during the process.

Benito López started on this project by making microreactor chips that could measure high-pressure chemical reactions in two ways: with stationary or continuously flowing substances. His first chip was made of silicon fibre and could withstand a pressure up to 600 bar. Finding the optimal flow was the next step. After experiments with materials, a tube-like structure that was completely etched with hydrogen fluoride was found to be the most suitable.

In such a chip, the researcher allowed chemical reactions to take place under pressures ranging from 110 to 690 bar with continuously flowing substances. Increasing pressure and the rapid mixing were found to favourably affect the rate of the reaction; up to 1.7 times faster than the advanced, expensive conventional equipment.

The reactions carried out were successful for pressures up to 600 bar and for volumes ranging from microlitres to nanolitres. The combination of pressure and the reduced dimensions of the equipment were found to

lead to faster reaction rates than in the equipment used to date, whilst the safety risks decreased significantly. Further on-line detectors can be attached to the chip with which the reaction can be monitored and therefore controlled.

The development of a miniaturised Total Analysis System ( $\mu$ TAS) is therefore no longer a thing of the future.

Source: Netherlands Organization for Scientific Research

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