Microreactors for heterogenous catalysis

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In heterogenous catalysis discovery and optimization of catalysts require extensive and expensive testing. Traditionally such tests are carried out in macroscale chemical reactors. In recent years microfabricated reactors have shown great potential as an analytic tool for catalytic testing due to several advantages such as a high sensitivity and fast temperature response [1]. In this work we present a microfabricated reactor with an integrated heater element and temperature sensor. The reactor is fabricated using UV photolithography and Deep Reactive Ion Etch.

The microreactor chip is seen in Fig. 1. It consists of a channel system and a circular, central reactor chamber with a volume of 240 nL [2]. Gasses are fed into the inlet holes, the gas runs through the reactor chamber and out through a capillary outlet which is connected to a quadropole mass spectrometer. A suitable catalyst material is placed in the reactor chamber before the chamber is closed by bonding a pyrex lid to the chip.

As an example reaction we will look at photooxidation of CO on a P25 catalyst. Approximately 2.6 µg of catalyst is placed in the reactor chamber by a spin coating technique and a pyrex lid is bonded to the reactor. The reactor is illuminated by a 4 W Hg lamp and the evolution of CO_2 is monitored by measuring the mass 44 signal with the mass spectrometer. The recorded signal is seen in Fig. 2, it is clear that CO_2 is evolved when the catalyst is illuminated.

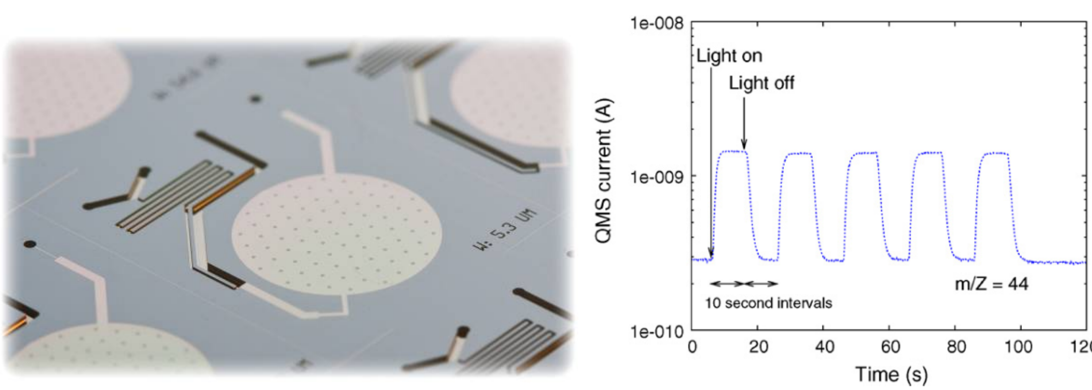

Figure 1. *Left:* Image showing the front side of the microreactor chip. The circular reactor area has a diameter of 10 mm and the depth of the reactor is just 3 µm. Right: Mass 44 signal recorded by the mass spectrometer as a function of time. It is clear that CO is oxidized to CO_2 when the catalyst is illuminated.

References

1. K. F. Jensen, Chemical Engineering Science, **56**, 293 (2001)
2. T. R. Henriksen, J. L. Olsen, P. C. K. Vesborg, I. Chorkendorff and O. Hansen, Review of Scientific Instruments, **80**, 124101 (2009).