Lab-on-a-chip devices as enabling technology for novel (bio)chemical studies using mid-IR synchrotron radiation

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Microchips for rapid mixing of two aqueous streams have been produced using CaF_2 wafers and SU-8 microstructuring technology. A special design allows fast mixing of minimal amounts of solutions. These lab-on-a-chip devices were tested at the IR beamline of Bessy II in Berlin, Germany. Advantage of the synchrotron radiation over thermal globar sources for measuring at sample spots close to the diffraction limit of the employed mid-IR radiation have been documented. The capability of the experimental set-up to initiate and monitor chemical reactions label-free in pL volumina was verified. Simple chemical reactions such as titration of acetic acid and conformational change of the protein β2-microglobulin have been recorded.

Similarly fabricated lab-on-a-chip devices for fast separation based on capillary electrophoresis (CE) have been employed in preliminary experiments at ANKA, Germany.

In order to employ the advantage of the imaging capabilities of the IR microscopes at Synchrotron beamlines cells could be immobilized by patch clamping at the sample spots of IR radiation. This would allow to monitor in-situ responses to chemical pulses generated by liquid handling in a lab-on-a-chip.