Microfluidics for High-Pressure Analyses

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When using appropriate materials and microfabrication techniques, the small dimensions and mechanical stability of microstructured devices allow for processes at high pressures without loss in safety. The largest area of applications has been demonstrated in chemistry, where extraction, synthesis and analyses often excel at high densities and high temperatures. These two parameters are accessible through high pressures. Capillary chemistry has been used since long but, just like in low-pressure applications, there are several advantages in using microfluidic platforms for control of reactions, catalysis, mixing and separation. For example, planar isothermal set-ups, large local variations in geometries, dense form factors, small dead volumes and precisely positioned microstructures.

In analytical systems, we are studying high-pressure components and microsystems for sampling, sample preparation, analyses and fractionation. We will present what drives our research and development: Our experimental set-up with high-pressure pumps, high-speed camera, sensors, valves, piston-chambers, backpressure regulators, cooling table, *etc*. How we have built capability in pumping and valving by the use of stainless steel and paraffin actuation. How we are making high pressure silicon-glass and glass-glass chips with integrated electrical thin film sensors, using printed circuit boards to ease handling of the chips and integrating modules. A set of relevant publications are listed below.

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[2] J. Cruz, S. Hooshmand, T. Graells, M. Andersson, J. Malmström, Z.G. Wu, and K. Hjort, J. Micromech. Microeng. 27, 084001 (2017).
[3] M. Andersson, K. Hjort, and L. Klintberg, Fracture strength of glass chips for high-pressure microfluidics, J. Micromech. Microeng. 26, 095009 (2016).
[4] Andersson, K. Hjort, and L. Klintberg, Fracture strength of glass chips for high-pressure microfluidics, J. Micromech. Microeng. 26, 095009 (2016).
[5] S. Knaust, M. Andersson, K. Hjort, L. Klintberg, Influence of surface modifications and channel structure for microflows of supercritical carbon dioxide and water, J. Supercrit. Fluids 107, 649–656 (2016).
[6] J. Jonsson, S. Ogden, L. Johansson, K. Hjort, and G. Thornell, Acoustically enriching, large-depth aquatic sampler, Lab Chip 12, 1619 - 1628 (2012).
[7] G. Sharma, L. Klintberg, and K. Hjort, Viton-based fluoroelastomer microfluidics, J. Micromech. Microeng. 21, 025016 (2011).
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[9] R. Bodén, K. Hjort, J.-Å. Schweitz, and U. Simu, Metallic micropump for high-pressure microfluidics, J. Micromech. Microeng. 18 (2008) 115009 (7pp). [