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TopSpot Vario: A Novel Microarrayer System for Highly Parallel Picoliter Dispensing

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This thesis reports about the conceptional design, development and characterization of a novel microarrayer system. In the last years microarray technology had a high impact in basic research, diagnostics and drug discovery. Its success caused huge activity in developing the most suitable microarrayer system. The here presented “TopSpot Vario” system bases on the already available TopSpot technology and improves this by replacing its pneumatic actuation principle by a direct liquid displacement method. Core is a silicon micromachined printhead with reservoirs for up to 24 different samples. Reservoirs and nozzles (order:6x4;pitch:500µm) are connected via self-filling capillaries. All printhead components were optimized by different test-structures and integrated into a finally used design which was extensively and systematically characterized by using statistical planning of experiments. A reliable exclusion of mixing between the samples is guaranteed by sealing all microchannels before printhead filling. Key of success for this approach was the invention of a new microchannel structure for bubble-free priming of blind channels. Compared to the standard TopSpot system, TopSpot Vario allows a much better tunability of droplet volume (250 pl-1.6 nl), a smaller minimum droplet volume (250 pl), a higher maximum printing frequency (400 Hz) and dispensing of higher viscous media (< 11 mPa). The system shows an intra nozzle reproducibility of droplet volume of 1.9% and an inter nozzle reproducibility of all 24 droplet volumes in one array of 7.5% at a droplet volume of 270 pl. Reproducibility of average droplet volumes of one array between different experiments was measured at 5%. With these values TopSpot Vario can compete with state-of-the-art microarrayers and its current development state allows its use for a highly flexible microarray production.