Particle Discrimination with an Improved Projection Cytometer

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An integrated cytometer is presented based on optical projection. A sheath flow focuses the particles closely over an integrated optical sensor capable of counting, sizing and measuring the shape of particles. Measurements demonstrate good repeatability and the ability to discriminate between particles based on their optical properties.

Cytometers are instruments for particle analysis based on the optical properties of the particle. In literature different integrated sheath-flow chambers have been presented (some early ones can be found in [1], [2]), but the optical sensors are often located off-chip. In this paper an integrated projection cytometer is presented that has a built-in optical sensor.

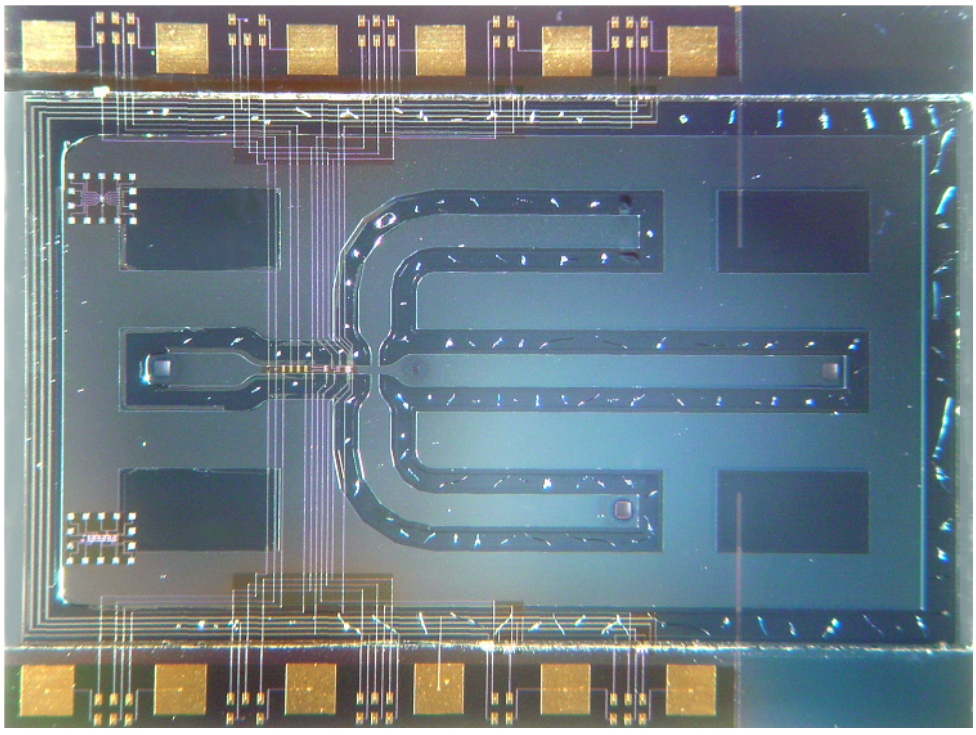

Fig. 1: The cytometer chip (1.5 x 2 cm^2)

The device (Fig. 1) consists of a transparent flow-channel that has an elongated photo-diode (1 x 50 μm^2) integrated in the bottom of this channel, aligned perpendicular to the direction of flow. By means of a non-coaxial sheath flow the sample liquid containing the particles is focused over the optical sensor. The chip is illuminated from the top and when a particle now passes over the sensor its optical properties are registered. The small projection distance realized by the sheath-flow minimizes the optical distortion of the particle projection, without the need for any additional optical components.

The shape of the sensor signal, caused by a passing particle, depends on the optical properties of the particle (Fig. 2). Since the sensor only consists of a single photodiode the optical properties of the particle are integrated along a line perpendicular to the direction of flow.

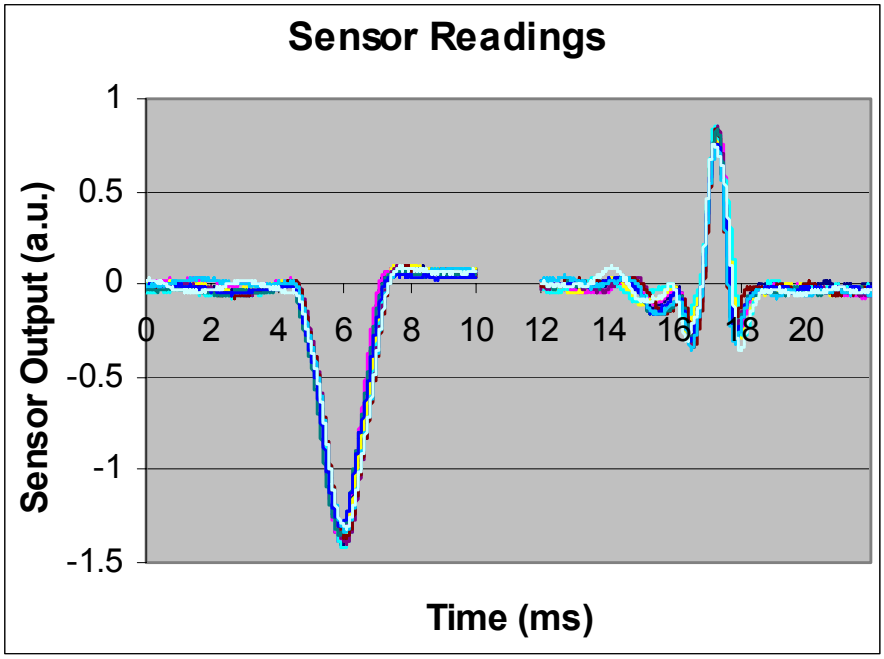

Fig. 2: Ten measurements printed on top of each other for 10 µm radius silver coated particles (left) and 12 µm radius plain particles (right) demonstrate the repeat-ability

References

[1] R. Miyake, H. Ohki, I. Yamazaki, R. Yabe, A Development of Micro Sheath Flow Chamber, proc. of MEMS '91, 1991, pp. 265-270.

[2] D. Sobek, A.M. Young, M.L. Gray, S.D. Senturia, "A microfabricated flow chamber for optical measurement in fluids", proc. MEMS '93, 1993, pp. 219-224.