MINIATURIZED MODULES FOR LIGHT SHEET MICROSCOPY WITH LOW CHROMATIC ABERRATION

Sarah Bruns\textsuperscript{1}, Thomas Bruns\textsuperscript{1}, Manfred Bauer\textsuperscript{2}, Hans Meyer\textsuperscript{2}, Dag Kubin\textsuperscript{2} and Herbert Schneckenburger\textsuperscript{1}

\textsuperscript{1} Aalen University, Institute of Applied Research, Aalen, Germany
\textsuperscript{2} J&M Analytik AG, Essingen, Germany

E-Mail: sarah.bruns@hs-aalen.de, info@j-m.de

KEY WORDS: SPIM, LSFM, fluorescence, astigmatism, achromatic illumination, cell spheroids

Since light sheet fluorescence microscopy (LSFM) is becoming more and more popular, the aim of our work was to develop miniaturized modules enabling LSFM with conventional inverted microscopes to provide this technique for a larger number of users. Within the scope of our project we developed two modules (Figure 1): In one module the light sheet is generated by a cylindrical lens as described earlier \cite{1}. The second module is mirror based, and the light sheet is generated by astigmatic distortion \cite{2}. Both modules are designed for connection of single mode fibers.

The great benefit of the mirror based module is that it is completely free of chromatic aberrations whereas the lens based system – although consisting of achromatic lenses – shows chromatic aberrations resulting in a focal shift of about 70 µm between wavelengths of 470 nm and 600 nm. Beam waists between 6 µm and 10 µm are maintained over distances of 140 µm (mirror based system) and 200 µm (lens based system) along the axis of illumination. Alternatively to lasers, LEDs with a narrow slit of e.g. 10 µm can be used for light sheet generation. Samples are commonly located in rectangular glass capillaries as described earlier \cite{1}.

Presently the mirror based module is motorized and the capillary holder is moved along the axis of detection to record z-stacks. The light sheet optics is readjusted in z-direction to compensate for the fish tank effect. The lens system presently is mechanically coupled to the objective turret of the microscope using an adjustable lever arm for discrete shift of the light sheet and the objective lens \cite{1}, i.e. instead of the sample here the light sheet and the objective lens are moved simultaneously along the axis of detection for z-stack recording. In general, both illumination systems can be mounted to the motorized setup or coupled mechanically. Exemplary results are depicted in Figure 2.
