



MULTISPECTRAL MULTI-CHANNEL SENSOR FOR INFECTION DIAGNOSTICS

Task

To diagnose infections, multiplex analyses are being conducted more and more often. These analyses can prove the existence of different pathogens in one single test step. To achieve this result, an assay is used, composed of different antibody dye conjugations, from which each specifically binds to a pathogen and can be distinguished from the remaining ones due to the spectral properties of its fluorophore.

Method

To conduct a multiplex test, Fraunhofer ILT has developed a fluorescent sensor that has 16 excitation and 16 detection channels. Every 4 of the 16 excitation channels have the same laser wavelength. In total, four excitation wavelengths are available: 405 nm, 473 nm, 514 nm and 638 nm. Each detection channel is spectrally tuned to the emission spectrum of a specific fluorophore, by which 16 different marked pathogenic agents can be detected simultaneously. Excitation as well as detection light is guided through optical fibers, which can be arranged according to the sample geometry. At the end of each fiber there is a micro-lens that focusses the excitation radiation in the analyte solution to be examined and collects the fluorescent light originating from it. A multichannel discriminator (MCD) was developed to deliver the sensitive detection of single photon events. This device transforms the short current pulses of a multi-anode photomultiplier (PMT) into TTL signals.

Each channel has a pulse shaper, with which the lengths of the voltage pulses of the PMT output can be adapted to the signal-processing electronics. A discriminator threshold adjustable for each channel allows the signal-to-noise ratio to be optimized.

Result

The multispectral multichannel sensor was set up for 16 channels. The detector noise, as well as the crosstalk between neighboring channels, was quantified. Crosstalk could not be detected. For the near-infrared sensitive photo cathode used, signal-to-noise ratios of the counting rate larger than 10 dB were reached under typical measuring conditions with the fluorescence markers used for detecting the pathogenic agents.

Applications

The multispectral multichannel sensor can be used to detect infectious diseases, auto-immune diseases or tumor markers in clinical diagnostics. It is suitable for examining research questions in the fields of bioanalytics, biochemistry and pharmacology.

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3 Multi-channel discriminator for sensitive detection of single photon events.

4 Excitation laser radiation of different wavelengths for the spectral multiplex test.