Time resolved fibre-optic sensing with CMOS SPAD line arrays

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Proteus
Identification of pulmonary infections and inflammation often lacks accurate in-situ diagnostics resulting in multi-drug treatment which can be inappropriate for patients in critical care. The EPSRC IRC Proteus project aims to develop a fibre-based sensing and imaging system allowing minimally invasive diagnosis in the distal lung. We aim to use novel multi-core fibres for multiplexed sensing together with advanced detector technologies for single-photon and time-resolved spectroscopy. This poster presents a fibre-based sensing methodology for physiological parameters such as pH through the use of exogenous fluorophores and molecular reporters (4-MBA functionalised Au nanoshells).

Aims
- Use of optical fibres for miniaturised in vivo point sensing
- Time-correlated single photon counting (TCSCP) methodology to enable time-resolved fluorescence and Raman spectroscopy
- Removal of unwanted background signal through time-gating

Time-resolved spectrograph
Versatile range of applications in fluorescence and Raman/SERS spectroscopy.

Line sensor ‘RA I’
- 256 x 2 pixel, each with 4 CMOS SPADs, optimised for 600nm-900nm
- 256 time-to-digital converters (TDC) for simultaneous read-out
- 43.7% fill-factor per pixel
- Operates in SPC (single photon counting), TCSCP and Histogram mode
- TDC resolution 423ps
- Jitter 0.8ns

Fluorescence spectroscopy
Distinguishing fluorophores from tissue autofluorescence

Background removal
Signal
Fluorescence intensity spectrum
Detector noise

Observing changes in fluorescent lifetime - pH Sensing
pH as a potential marker of tissue acid-base status

Raman/SERS spectroscopy
Time gating allows background suppression and enhances the SERS signal.

References

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