LED LIGHT SOURCES FOR FLUORESCENCE MICROSCOPY

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Light emitting diodes are a rapidly evolving technology with the brightness of available devices developing according to their own version of Moore’s law and doubling approximately every 18-24 months. The available devices today cover a wide spectral range and are now bright enough to compete with conventional lamp technologies as suitable sources for fluorescence microscopy. In addition, they offer the significant advantage that the light output can be electrically controlled on nanosecond timescales and they can be patterned using semiconductor processing techniques to produce programmable structured light sources.

Figure 1: X60 merged frequency domain fluorescence lifetime images of a molecular probes standard muntjac skin fibroblast obtained with a directly modulated tricolour LED.

We demonstrate how these advantages can be used in the realisation of a range advanced optical fluorescence microscopy techniques. We show how cheap of the shelf devices can be driven sinusoidally or in pulsed mode as sources in both frequency and time domain fluorescence lifetime imaging systems – replacing the acousto-optic modulators or ultrafast laser systems conventionally used. We also show how a structured LED consisting of an array of lines[1] can be used programmable to realise optical sectioned imaging by structured illumination and line scanning confocal techniques – all in a single compact solid-state device with no moving parts.