Supplementary Information (SI) for Analyst.


# Supporting Information

# Time-domain luminescence lifetime imaging with oxygen sensor particles in presence of actinic light

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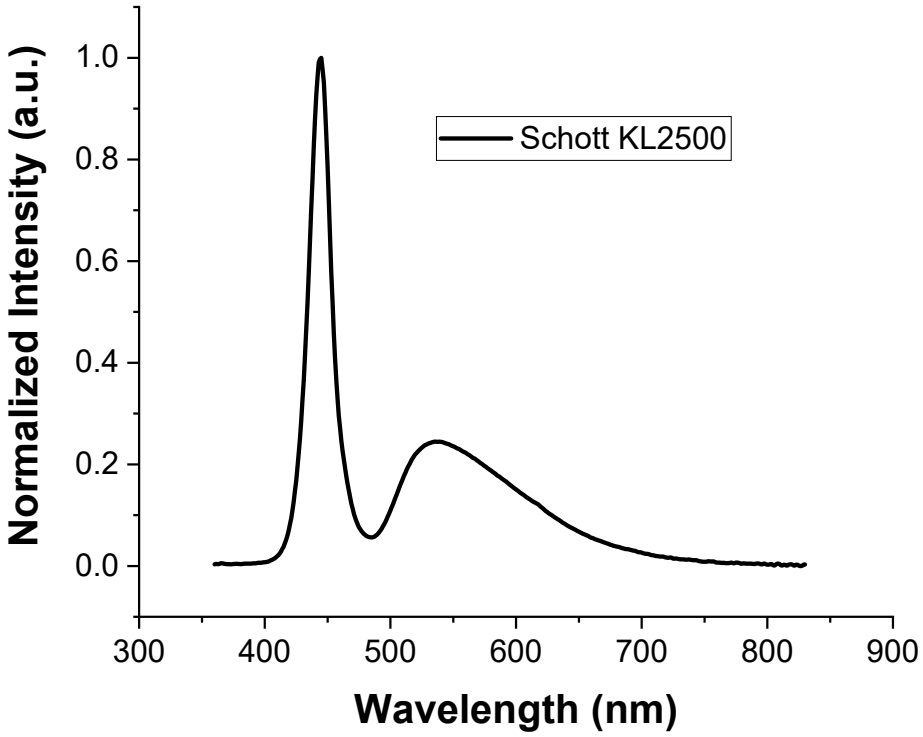


***Figure S 1**. Emission spectrum of actinic light source (KL2500LED; Schott GmbH).*

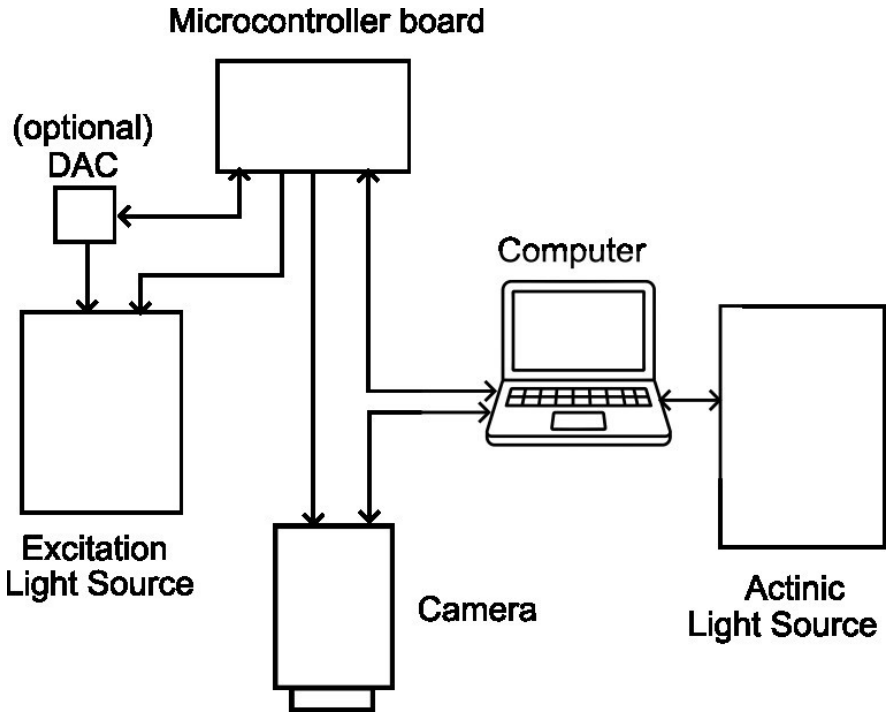


***Figure S 2**. Schematic overview of the time-gated imaging system components: Modulated CMOS camera with multi-exposure mode (MC124MG-SY-UB; Ximea); Microcontroller board (Uno rev3; Arduino) for timing control of the camera and excitation light source trigger pulses; 12 bit digital to analog (DAC) module (Gravity I2C 12-Bit DAC module; DFRobot) for controlling the light intensity of the excitation light source; an excitation light source (Red LED, 612 nm; LPS3, ila5150; Ila GmbH, or red LED 625 nm of a multichannel light engine (LEDHub, Omicron GmbH; actinic light source (KL2500LED, Schott GmbH), which is controlled by the system software.*

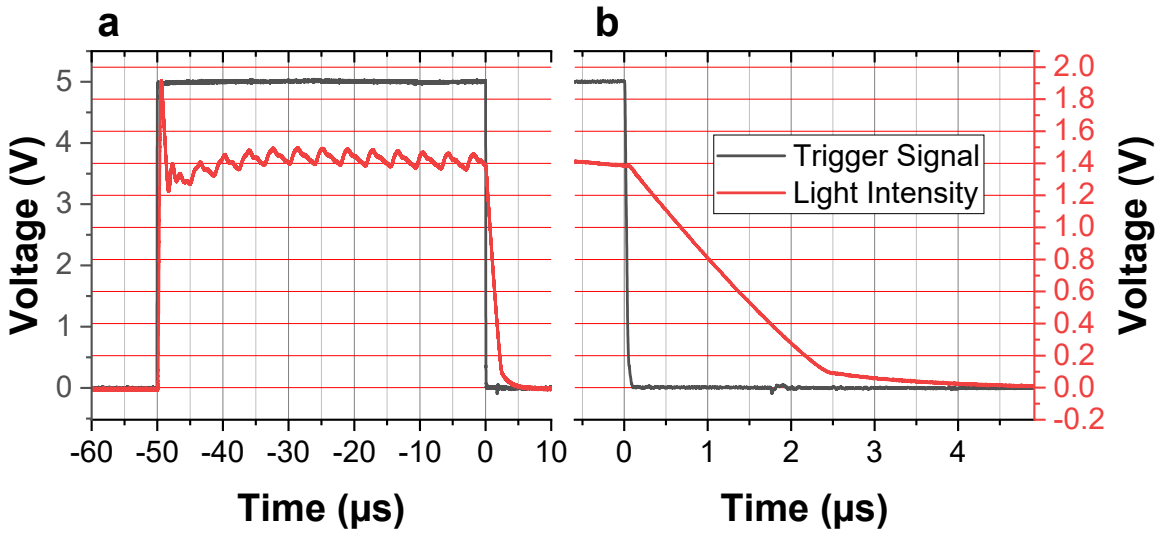


***Figure S 3**. Oscilloscope measurement of emission light intensity profile (a) and fall time (b) of a 50 µs light pulse from red LPS3 LED lamp used as an excitation light source in the lifetime imaging system.*

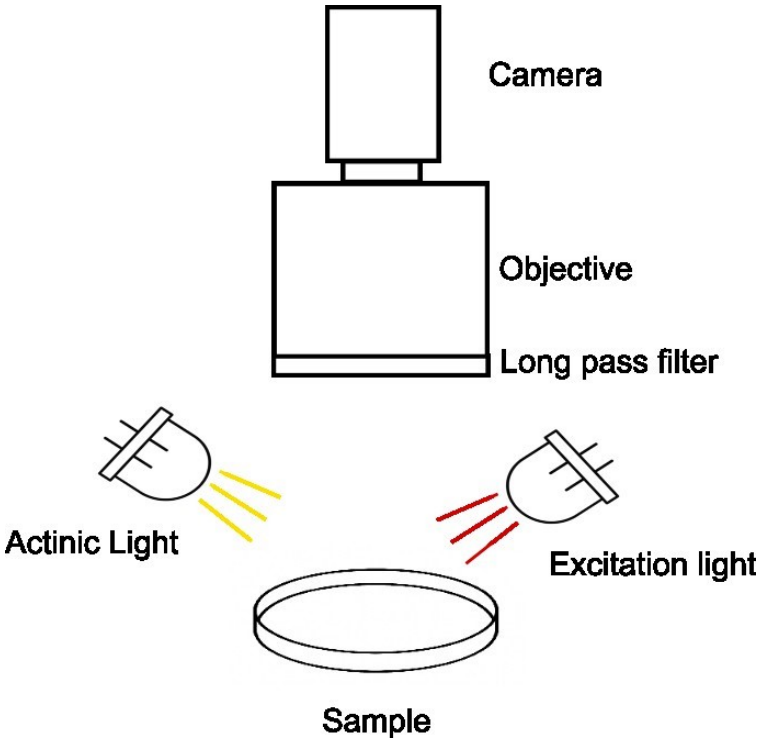


***Figure S 4**. Schematic of the optical setup used for imaging the biofilm sample. The output from the actinic- and excitation light source was directed towards the sample via light guides.*

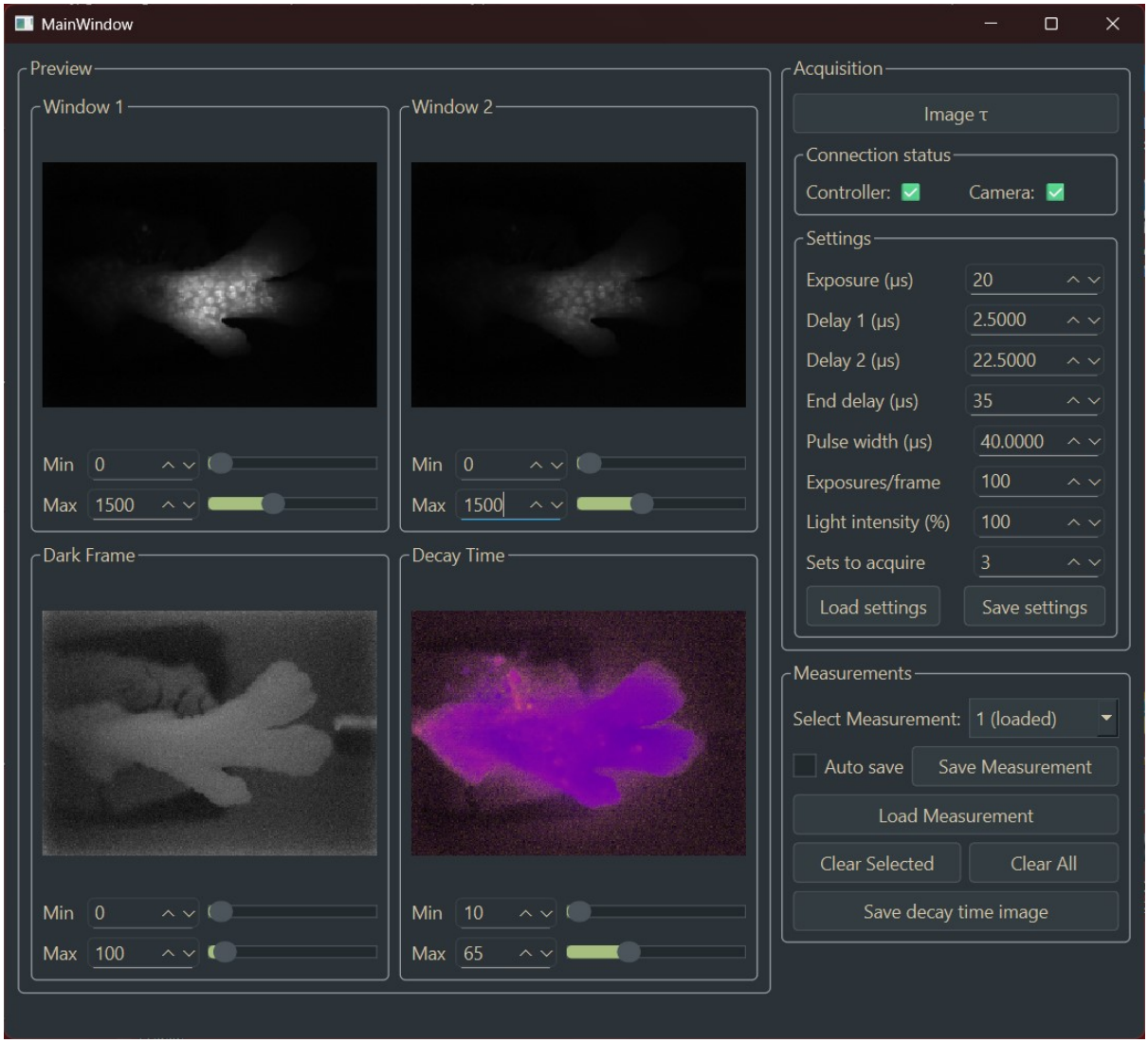


***Figure S 5**. Screenshot of graphical user interface used for time-gated lifetime imaging. The images in the preview area show intensity images for window 1, 2 and the dark image (top left, top right, bottom left, respectively; images of the first set in a measurement are shown) and the calculated lifetime image (average lifetime of all acquired sets in the measurement). Intensity/lifetime ranges can be adjusted with the min/max sliders or spin boxes under the images. Acquisition starts by pressing the "Image τ" button with the settings in the "Settings" area below. Delay 1 and 2 take the input delay of the camera into account (connection dependent propagation delays are not taken into account). The "End delay" does not affect measurements but is needed for the camera to accept the next trigger signal in multiple exposures per frame mode (a too short end delay will lead to a timeout error); this depends on the used camera and camera settings. The pulse width and light intensity (optional, requires external DAC module) refer to the excitation light. The "sets to acquire" spin box specifies the number of full measurements with acquisition of window 1, 2 and dark frame; the lifetime of multiple sets in a measurement is averaged to increase S/N ratio. The camera and microcontroller automatically connect, with the connection status shown in the "Connection status" area. Settings and measurements can be loaded with the respective buttons in the "Settings" and "Measurements" area, respectively. Different previous measurements (measured in the session or loaded) can be selected in the "Select Measurement" combo box in the "Measurements" area.*

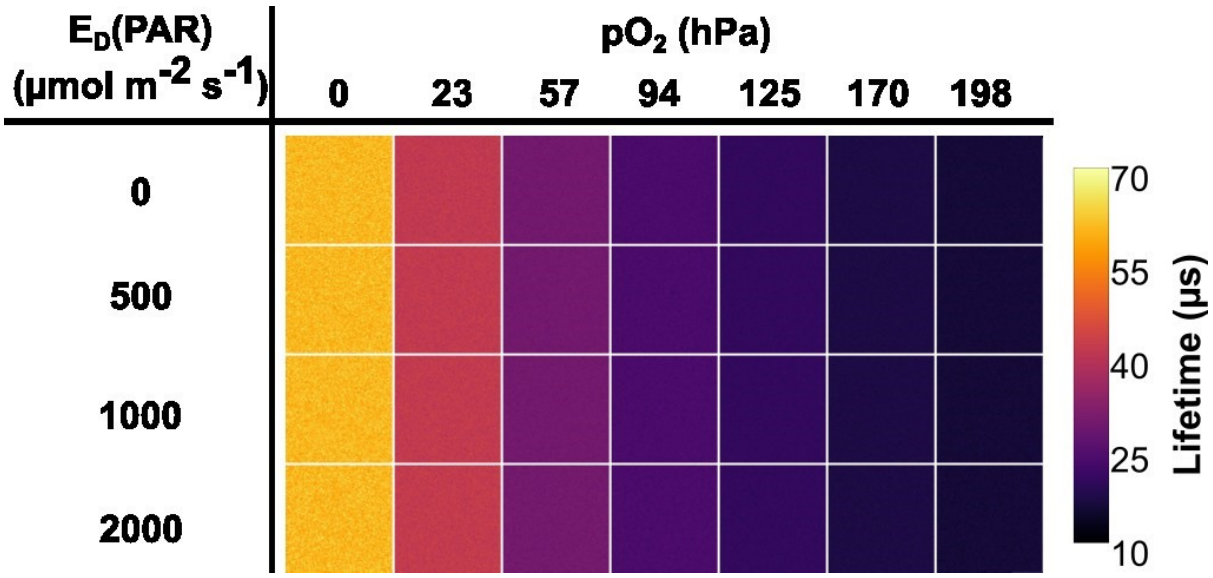


***Figure S 6**. Calibration lifetime images for **PS-VP** $O_2$ sensor particles. The corresponding calibration curve is shown in **Figure 1**b.*

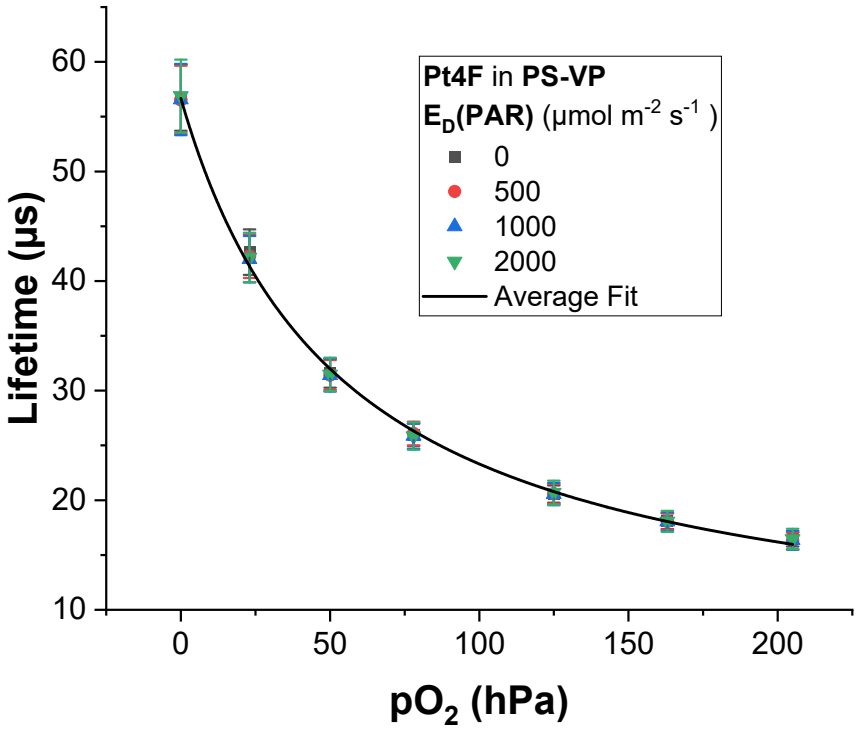


***Figure S 7**. Calibration of optical sensor particles (**Pt4F** in **PS-VP**) using a PCO Sensicam.Sensimod imaging system [1] with correct background correction in the presence of various intensities of broadband actinic light.*

# References

1G. Holst, O. Kohls, I. Klimant, B. König, M. Kühl and T. Richter, *Sensors and Actuators B: Chemical*, 1998, **51**, 163–170.