



Application Note:

Fluorescence spectroscopy of marked cells with “FluoDuoFiber” multichannel fiber optic system

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Supported by:



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Introduction

Within the scope of “RoVitaS” project done by **art photonics** in collaboration with TissUse, TU-Berlin, GeSIM and Fraunhofer IWS, Dresden, the new fiber optics system was developed for fluorescence sensing of human cells vitality in Multi-Organ-Chips (MOC).

In order of MOC handling automation our project partners have developed a prototype of robotic system which enables autonomic hosting of 10 to 24 MOCs. For this system **art photonics** has developed a flexible fiber optic probe and dual-channel photometer based on 2 photomultipliers and 2 LED light sources – to measure fluorescence signal emitted by the cells marked with CellTracker Green and Red. Parameters of “FluoDuoFiber” system have been defined in tests with CellTracker marked cells in different concentrations.

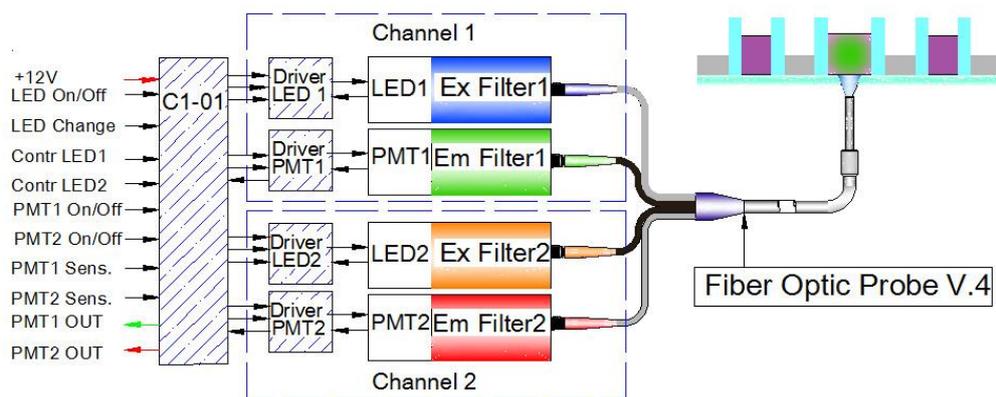


Fig. 1 “FluoDuoFiber” System

The multichannel fiber optic probe (Fig. 2) used in “FluoDuoFiber” system has 4 legs (2 for each wavelength channel) and a common distal end (bundle) directed to the MOC cells chamber. The probe legs used for excitation light delivery from LED are made from optical glass fiber bundle and designed for high coupling efficiency with LED light sources. The detecting fiber bundle in distal end center is made with a special fiber arrangement to

collect the proper ratio of fluorescence signal from MOC cell and deliver it to two PMT in good accordance with each LED power and cells marker intensity. The probe is protected by very flexible tubing and can be easily installed in robotic system.

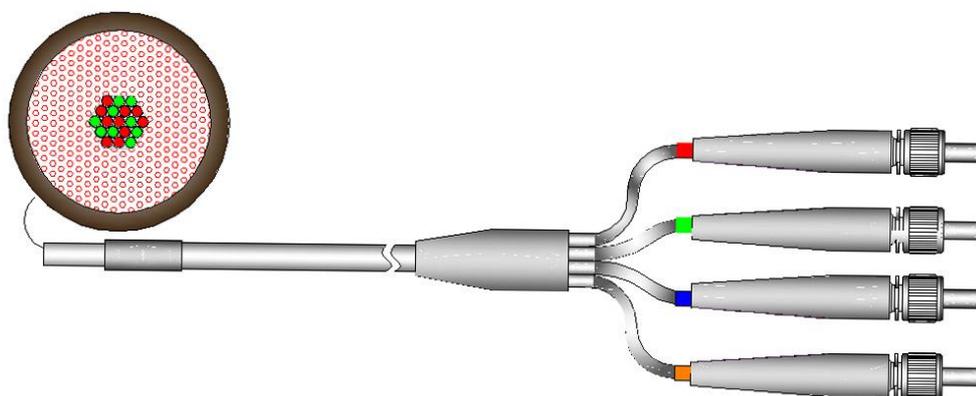


Fig. 2 Multichannel Fiber Optic Probe

Experimental tests

“FluoDuoFiber” system was tested with two types of living cell cultures – grown in MOC and fixed in another type of carrier for biomedical cells cultures:

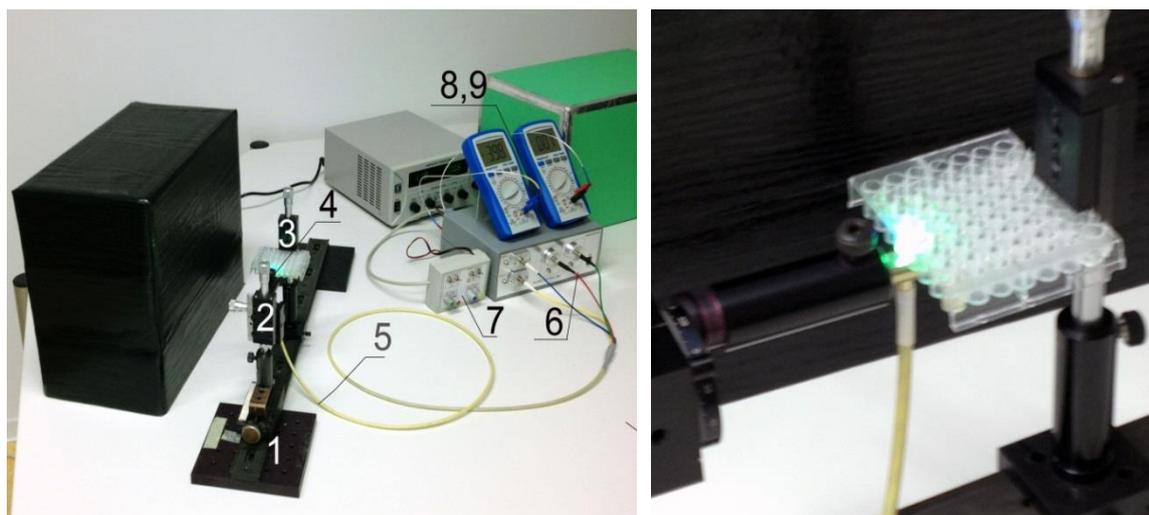


Fig.3 Experimental test set-up



1) Adaptable platform; 2) Fiber Probe Holder; 3) Biochip Holder; 4) Excitation light spot under cell; 5) Flexible Fiber Probe; 6) “FluoDuoFiber” system; 7) Hand Set Simulations Device; 8,9) Digital Outputs of PMT-1 & PMT-2

Test results

Fluorescent signal for living cells marked by CellTracker Green was measured with “FluoDuoFiber” system for different cells concentration (see Fig. 4 with correspondent dependence). Sensitivity of “FluoDuoFiber” system was approved in a good match with the need to control living cell content in pragmatic range for MOC applications – from 100.000 to 500.000cells/ml

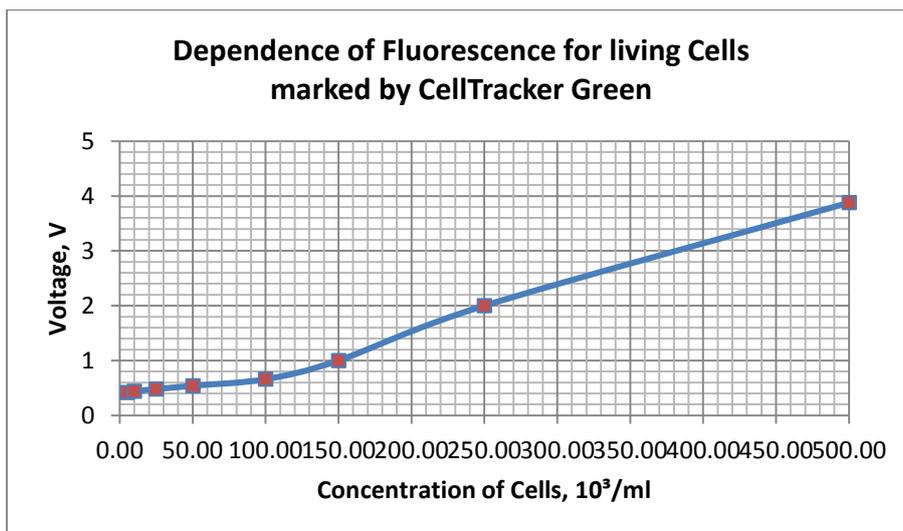


Fig. 4 Detected Voltage from PMT1 vs Concentration of living Cells (labeled with CellTracker Green).

Summary

“FluoDuoFiber” system was designed and fabricated as the 1st prototype consisting of:

- **Multichannel Spectral fluorescence Fiber Probe** based on 4 channel fiber bundle combining dual channel collection bundles made with Metal coated Silica fibers and dual channel illumination bundles made from glass fibers with High Numerical Aperture - to enable high coupling efficiency with LED. High flexibility of multichannel probe enables its distal end motion in robotic system “RoVitaS” designed for control of many MOCs (from 10 to 24 MOC).
- **Dual Channel Process Photometry Device** to monitor living cells concentration labeled by CellTracker Green and CellTracker Red – measuring their fluorescence intensity with the multichannel fiber probe under the transparent bottom of MOCs fixed in Robotic system.



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- Modular platform of *"FluoDuoFiber"* system allows changing LED and diode lasers for different excitation wavelengths – with correspondent filter changes in PMT channels. **Dual channel system and correspondent fiber probes can be also modified to triple or more channels and can be customized not only for its use in lab, but for a broad variety of another applications - from reaction monitoring in bioreactors up to the clinical diagnostics of cancer and other diseases even through the instrumental channels of endoscopes.**