EPIC
European Photonics Industry Consortium

NETHERLANDS CANCER INSTITUTE
ANTONI VAN LEEUWENHOEK

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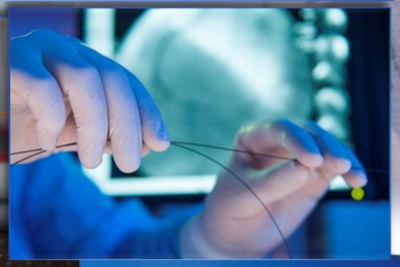
11-12 December 2019
Amsterdam, The Netherlands

Advanced fiber optic solutions for intraoperative diagnostics and theranostics

Viacheslav Artyushenko



Metal coated Silica and CIR- & PIR-fibres

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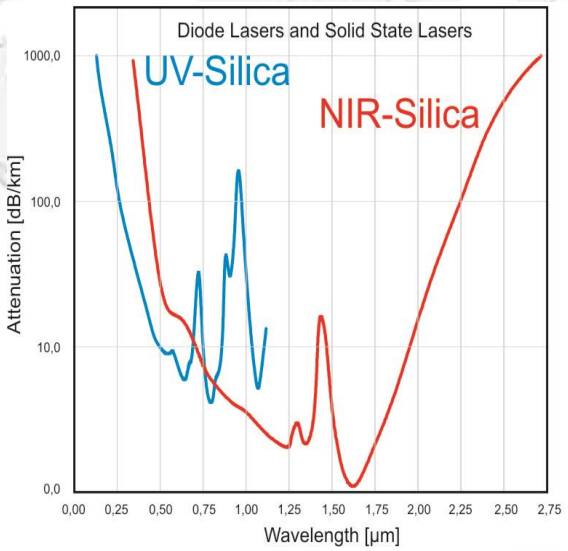
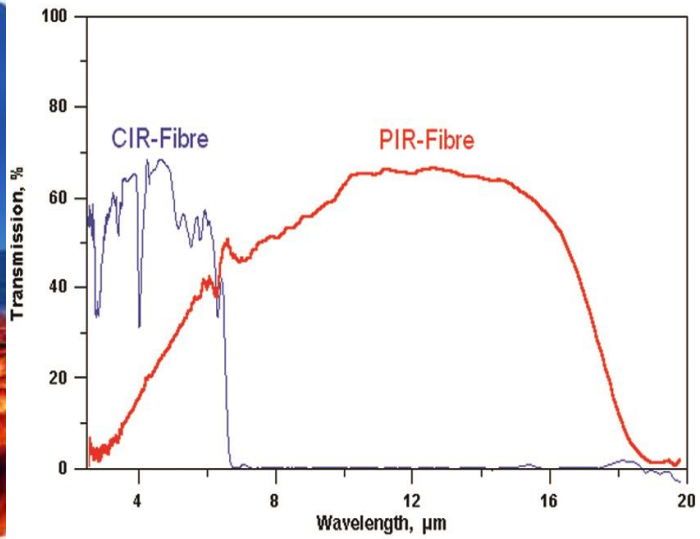
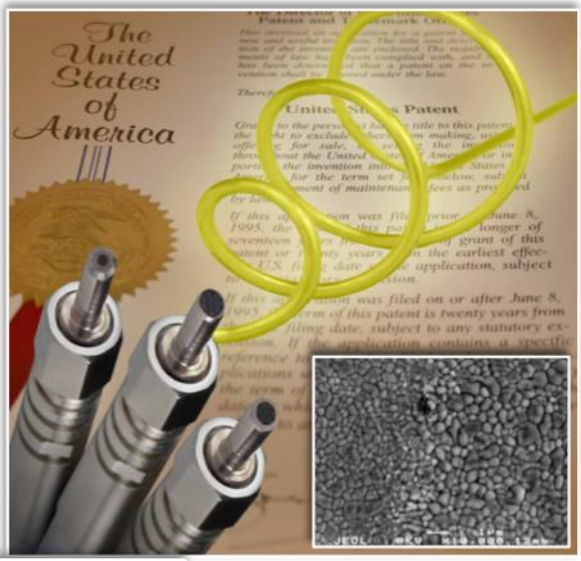




Alu- or Copper coating for Silica fibers enables to use them up to 350-800°C



Polycrystalline IR-fibres for Mid IR-range: 3-18µm (PIR-fibers) are extruded from Silver Halide solid solution crystals

Chalcogenide IR-fibers (CIR-fibers) from As-S glasses are the best for 1-6µm range

broad spectra fiber solutions

Fiber Optics Drive Innovation in the Operating Room

Photonics Online
Article | November 12, 2018
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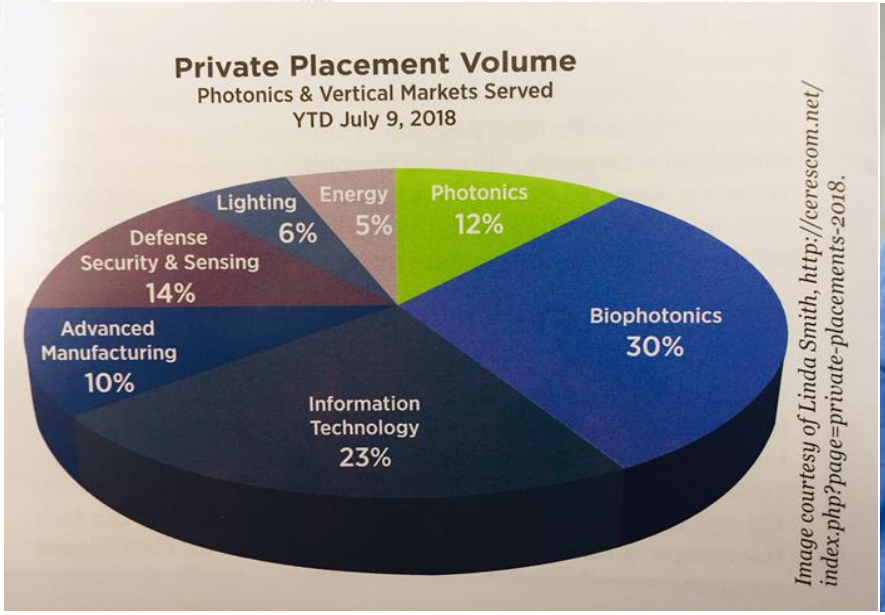
Source: SCHOTT North America, Inc. - Lighting and Imaging

By Nilesh Samant, Sales Manager, SCHOTT North America Inc.



With their unique ability to transmit light and images while remaining flexible, optical fibers have been an enabling technology in the operating room for decades. They are the key technology in endoscopes, which revolutionized medicine by providing surgeons a view into the body that allows them to operate through natural openings or tiny slits in the body, greatly reducing recovery time. Endoscopes also provide critical visual access to internal organs and tissues, allowing doctors to look for cancer and damaged tissue.

PIR- & CIR-fibers for 1-18µm

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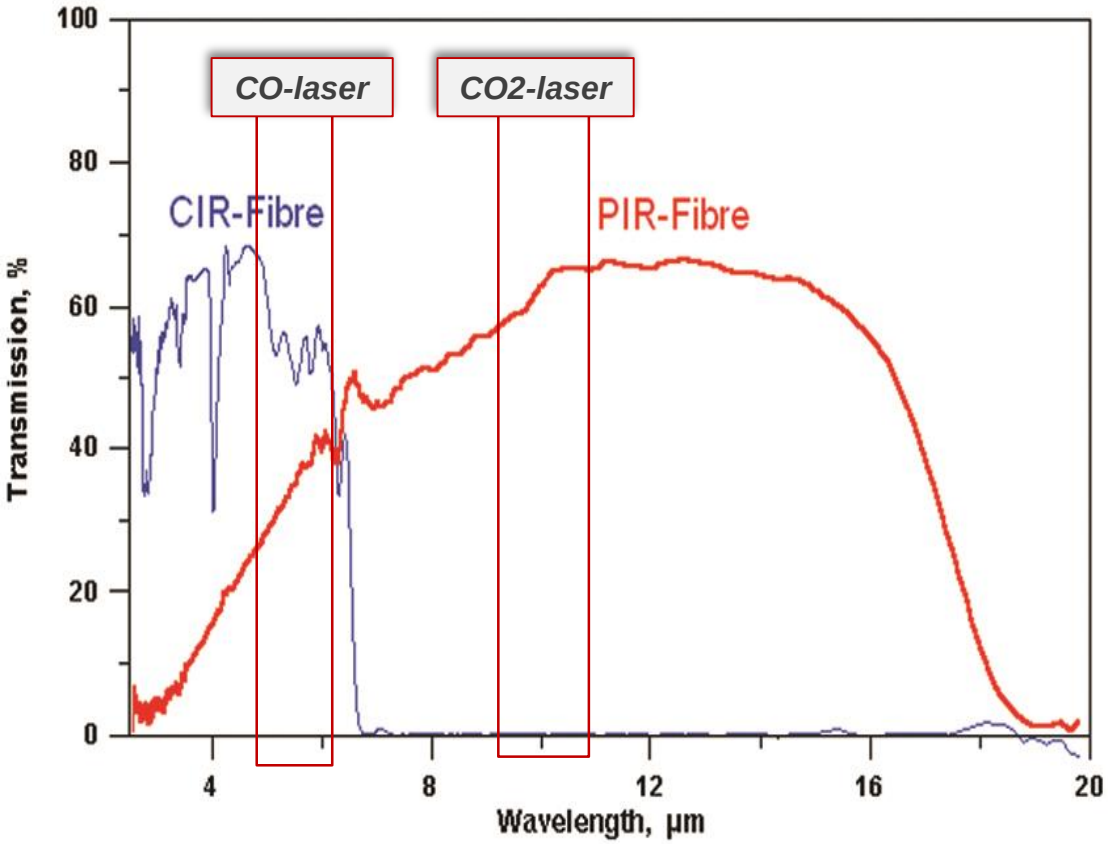

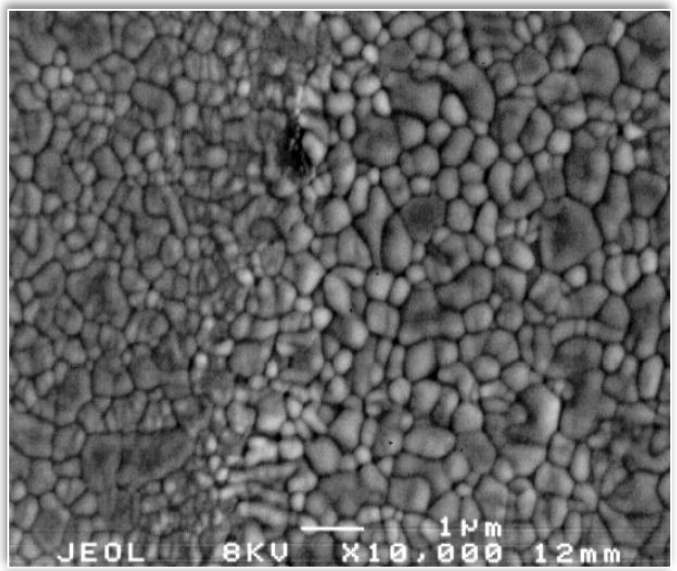

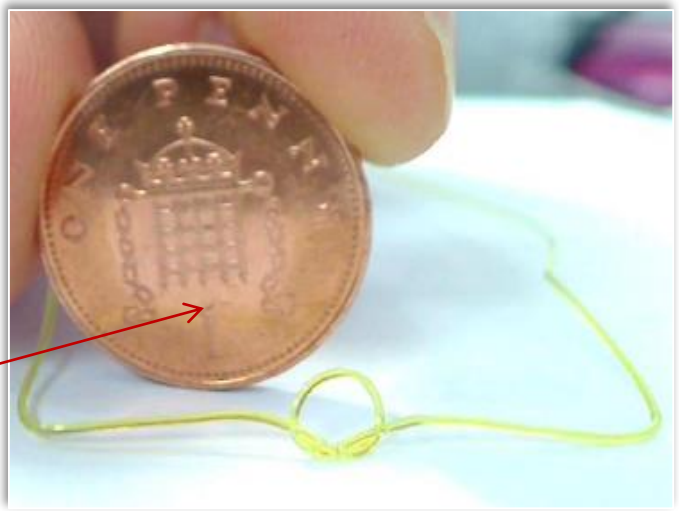

Polycrystalline IR-fibers (PIR-fibers) extruded from AgCl:AgBr crystals with sub-micron structure are the best for 3-17µm. They are non-toxic, non-hygroscopic, and very flexible

PIR-Fiber Cables for CO- & CO2-Lasers

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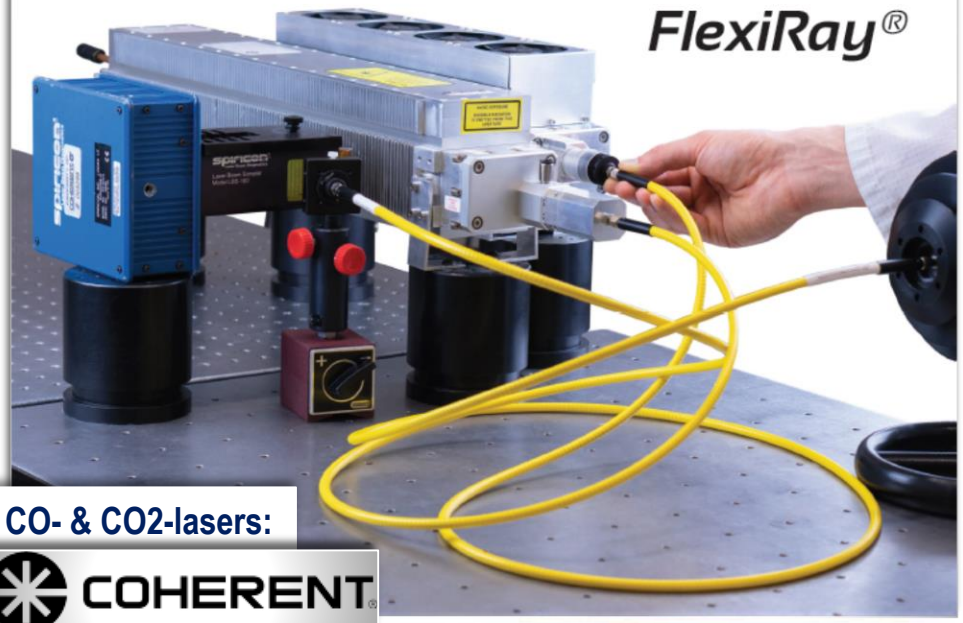
High Power PIR-fiber Cables can deliver power of CO-lasers at 5.2-6.2µm & CO_2-lasers at 9-11µm. Special design of HP-connectors includes the special SMART-treatment of fiber ends - to suppress Fresnel reflection for >2 times

"New CO Laser Technology offers processing benefits"
by Andrew Held, ***Coherent Inc.***
Photonics Spectra, *p.34, September 2015*

CO2-laser from *MedArt*

- The most flexible cables for CO- & CO_2-laser power delivery
- Stable transmission under small bending radius
- SMART-technology to suppress Fresnel reflection losses



CO- & CO2-lasers:

COHERENT

Mid IR-Fiber Pyrometry in 3-16µm Range

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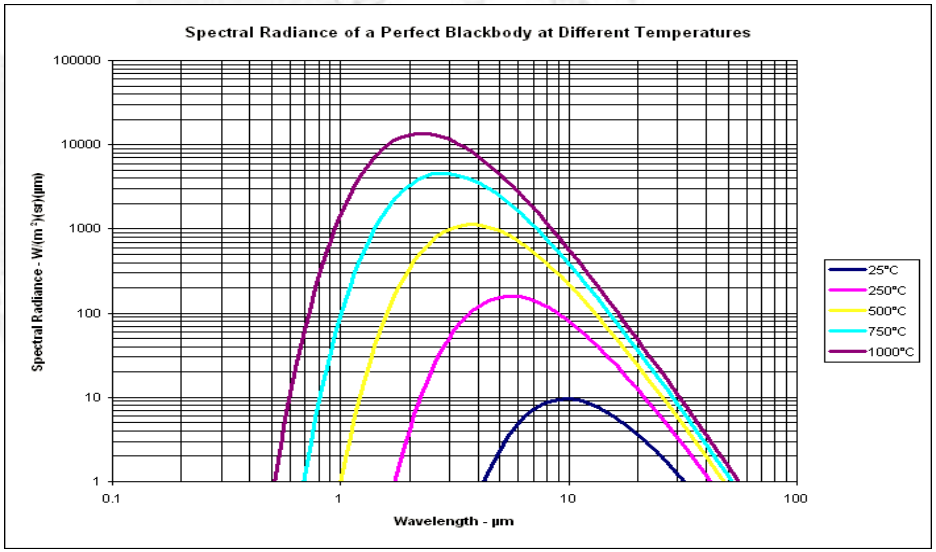

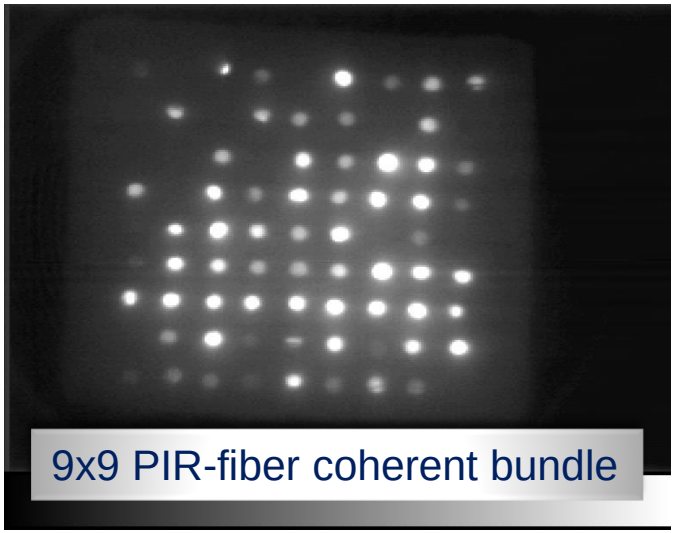

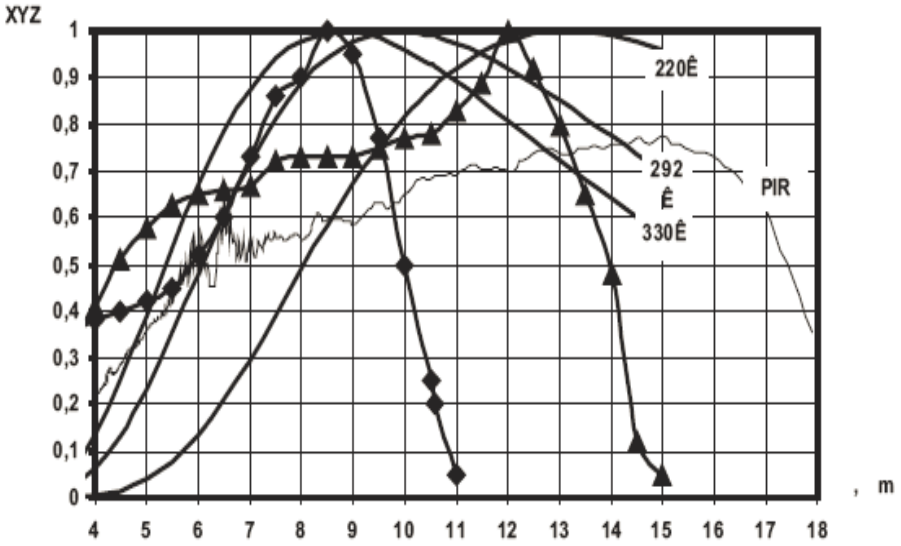

PIR-fiber Endoscopic IR-imaging

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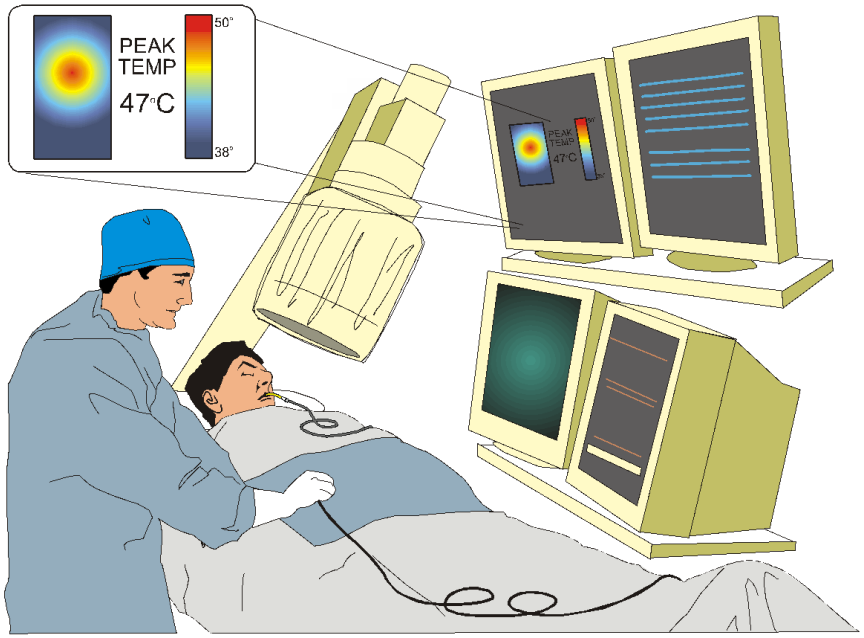
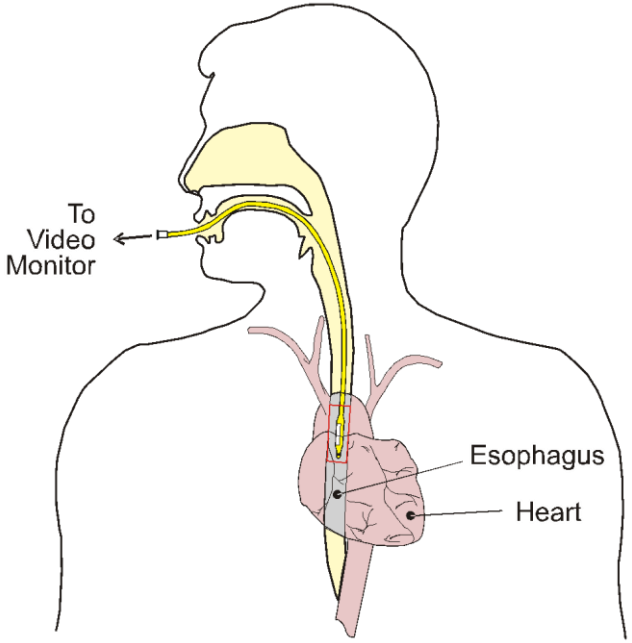
Boston Scientific

Thermographic Imaging System to use during RF-ablation for arrythmia patients

Monitor: Continuous, high-resolution thermal image

Probe: Esophageal infrared thermal mapping catheter

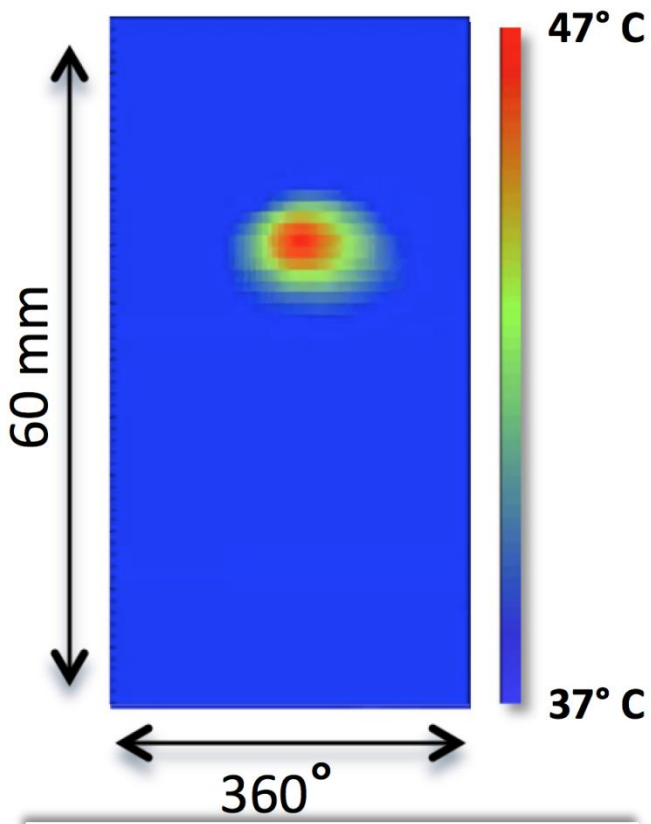




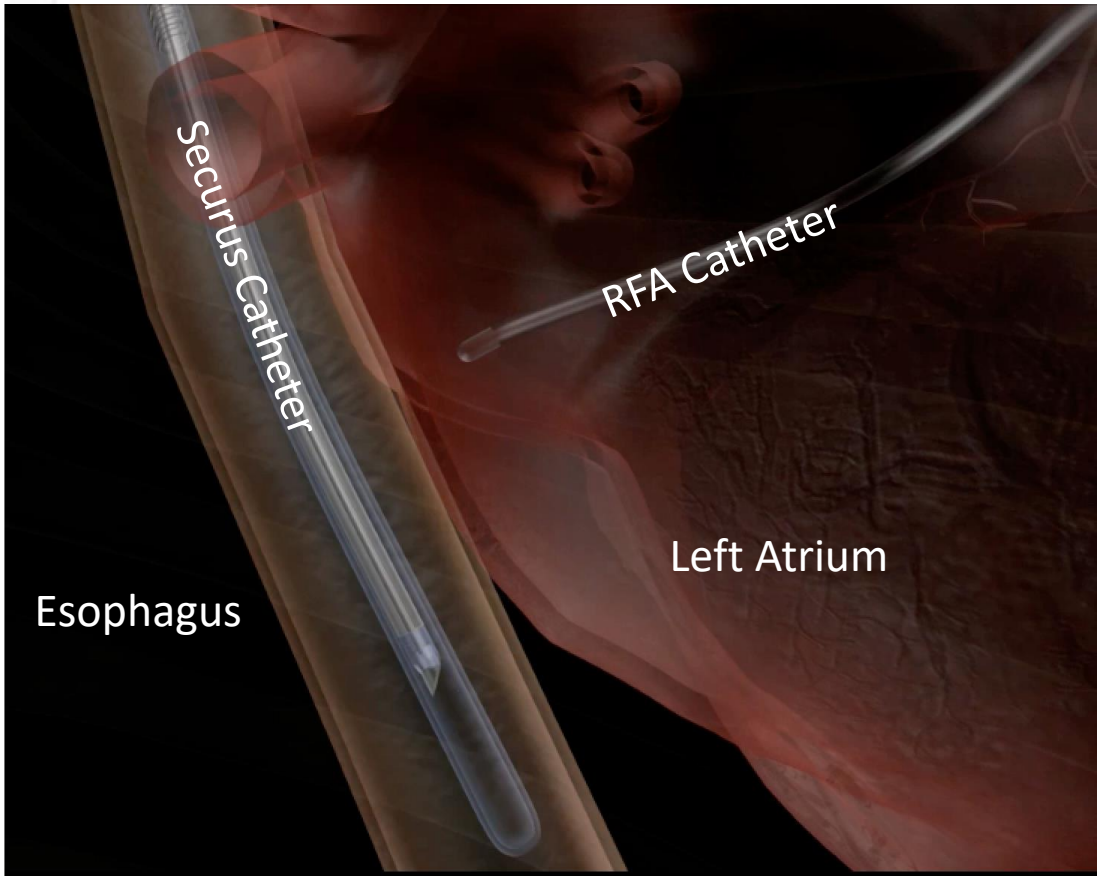
PIR-fiber Endoscopic Pyrometry

PIR-Fiber IR-imaging Endoscope

FDA clearance from February 2018



PIR-fiber Endoscope with OD=2mm & 0,1C sensitivity



Cancer Diagnostics with ATR-fiber Coupled FTIR

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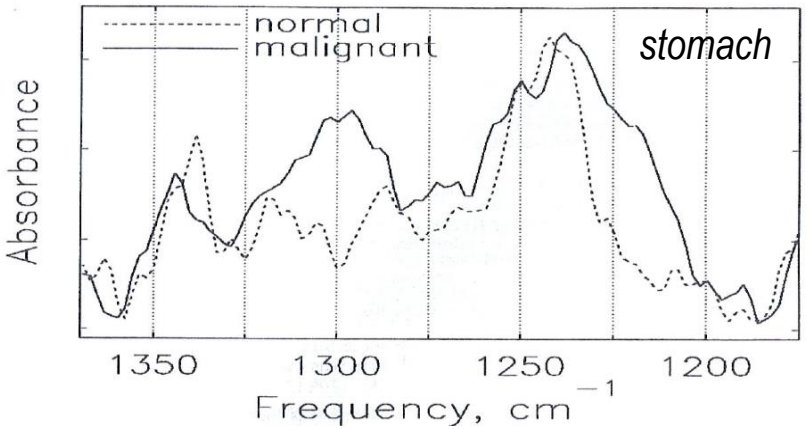
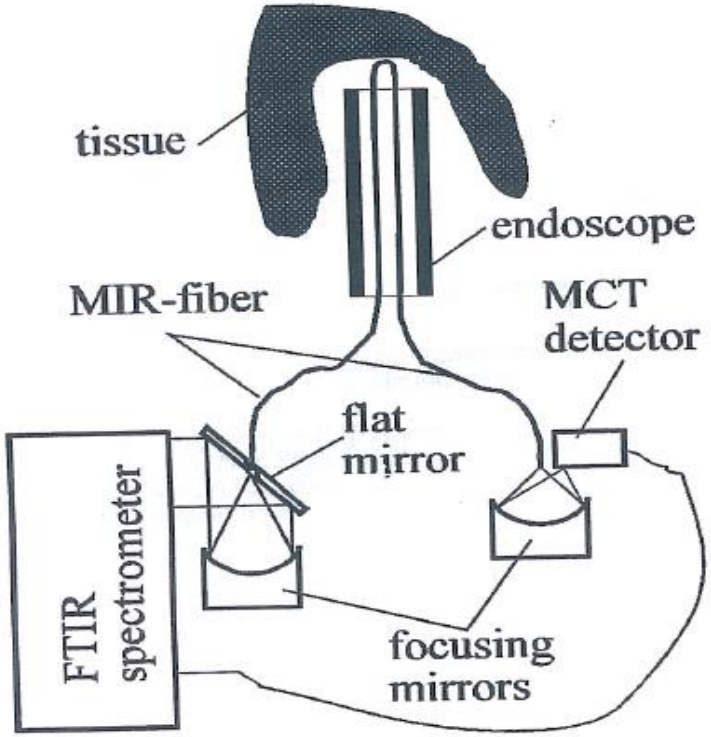
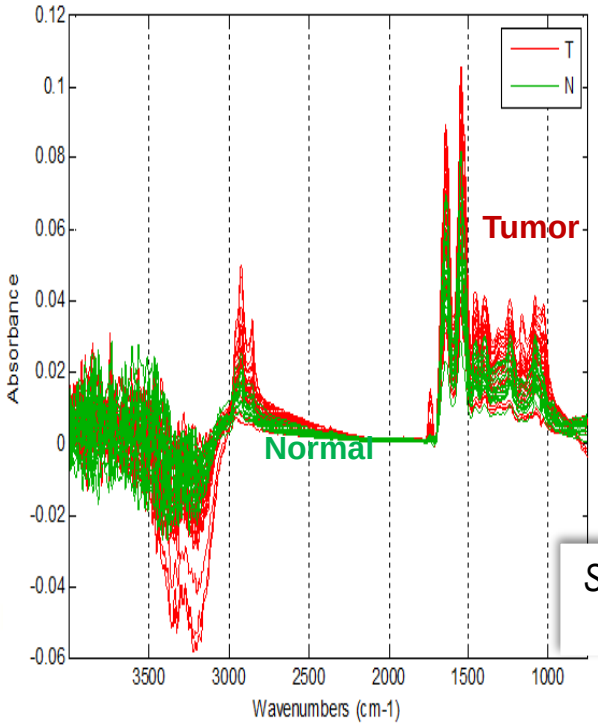
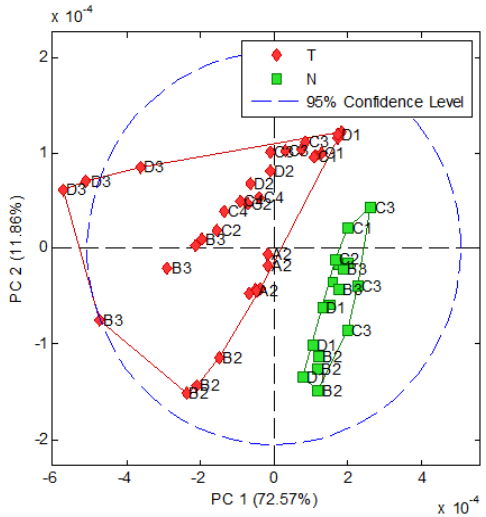


Our spectroscopy detection of the stomach cancer by FTIR-fiber spectroscopy *ex-vivo were* have been started in 1992-1993 (see spectra at the right) - with the 1st data published in 1994-1995 (Proc. SPIE v.2328, 76-81, v.2631, etc.). Our tests in Berlin on 2015-2016 made for kidney RC-carcinoma have confirmed glucose role as this tumor biomarker together with the lipid/ water ratio







*Spectra of **normal** & **tumor** kidney tissue with PCA spectra analysis*

Label Free 4 Fiber Spectroscopy Methods

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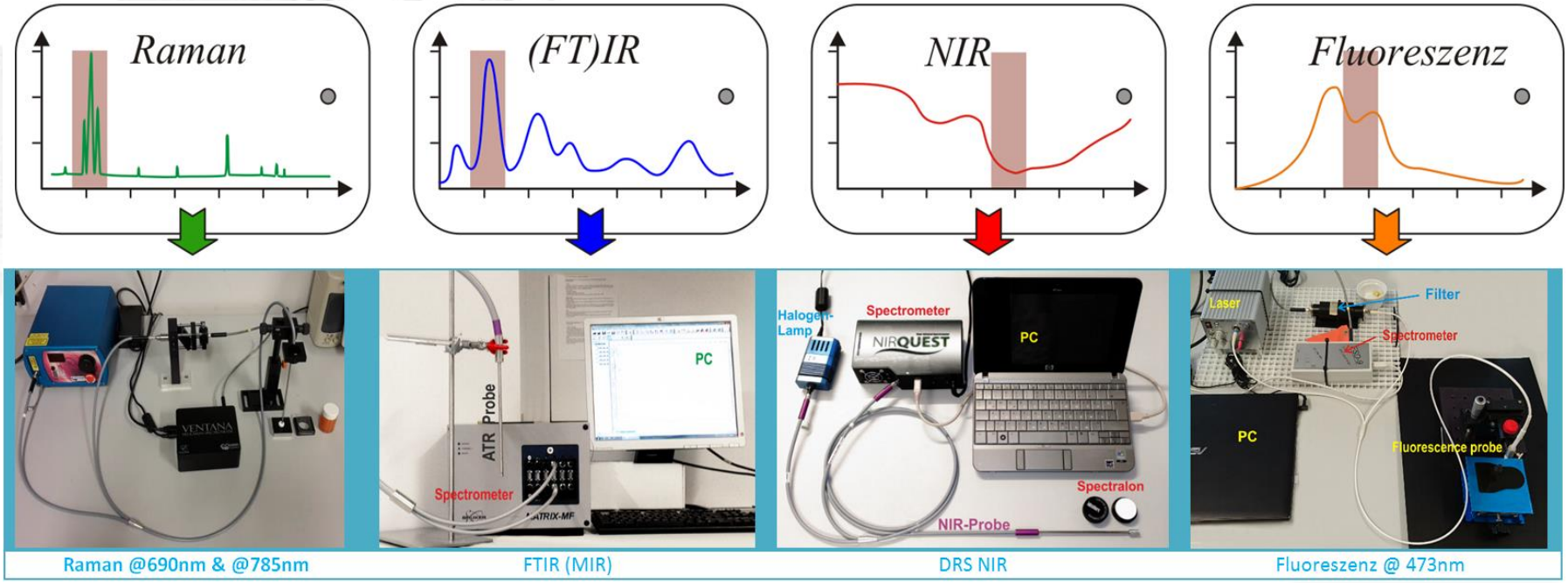
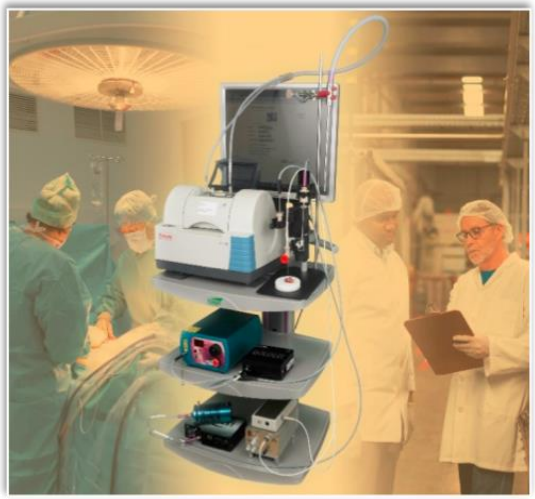
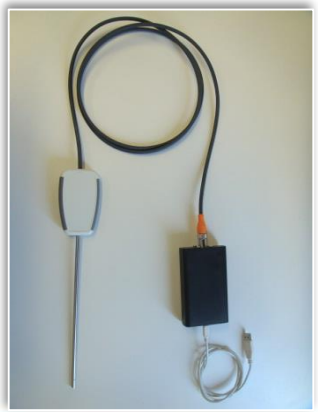


Raman @690nm & @785nm | FTIR (MIR) | DRS NIR | Fluoreszenz @ 473nm



Comparison of all 4 key spectroscopy methods done for the same tissue spots enables to select the best one (or the best combination) for the most sensitive, specific and accurate detection of tumor margins. It'll define design of organ specific spectral fiber sensor – to make it portable, fast, cheap and easy to use.



3 Spectroscopy Methods Coming to Clinics

National University of Singapore

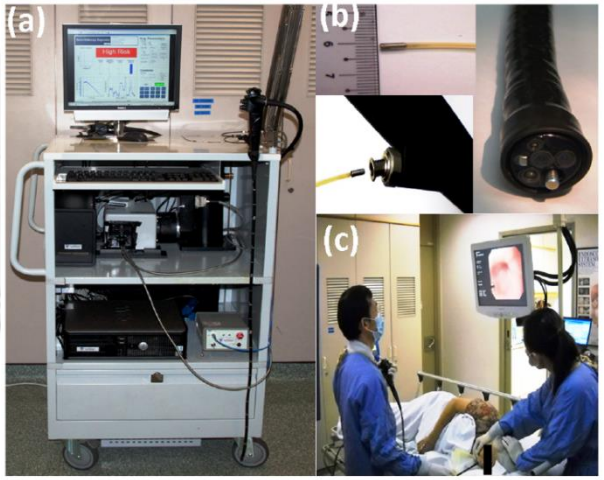
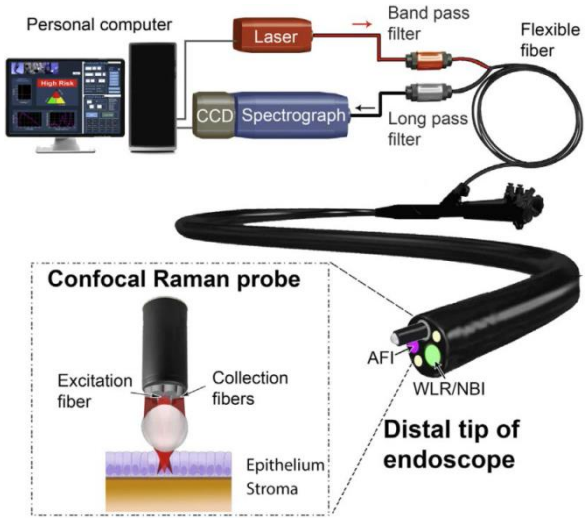
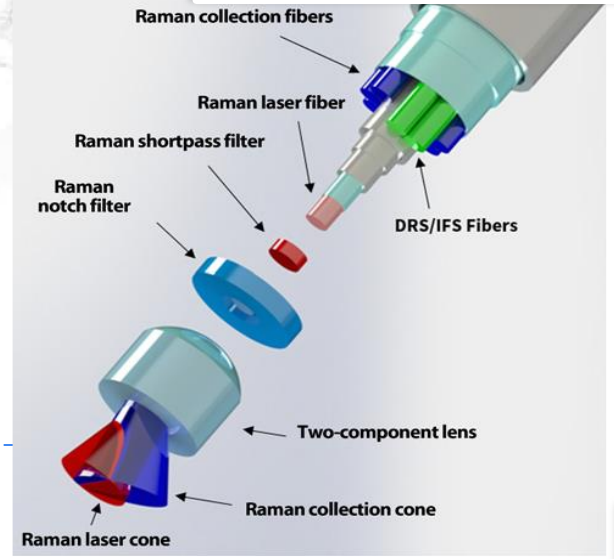


Fig. 1 (a) Photograph of Raman endoscopy system in clinic; (b) insertion of the 1.8 mm Raman endoscopic probe into the working channel of an endoscope during gastroscopy; and (c) routine Raman endoscopy procedure in clinic.



Highly Accurate Detection of Cancer *In Situ* with Intraoperative, Label-Free, Multimodal Optical Spectroscopy

Cancer Res; 77(14) July 15, 2017



DRS for identification of breast cancer in lumpectomy specimens

Lisanne de Boer
EPIC Workshop
2-3.07.14, Rotterdam

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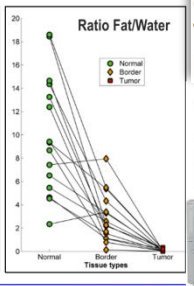
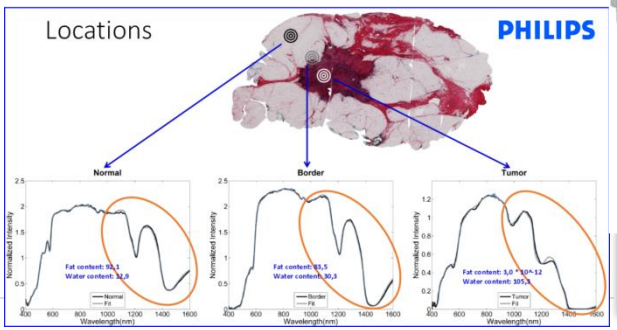


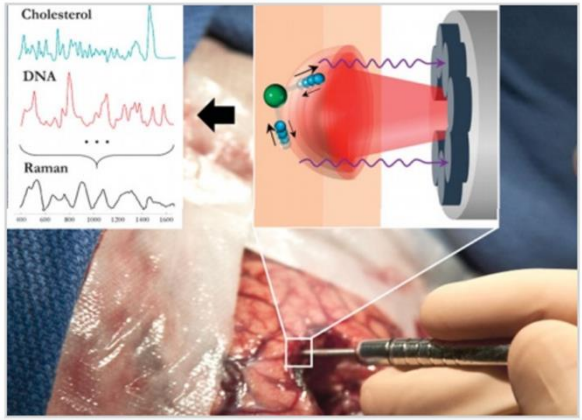


Montreal Polytechnique & McGill University

New laser probe identifies brain cancer cells in real time

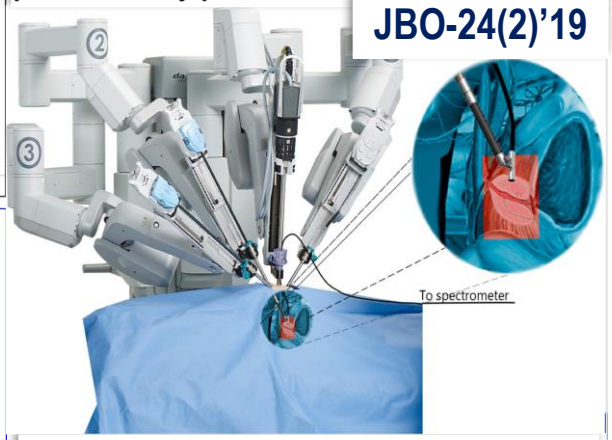
Promises to improves tumor surgeries and extend survival times for brain cancer patients

February 16, 2015



Integration of a Raman spectroscopy system to a robotic-assisted surgical system for real-time tissue characterization during radical prostatectomy procedures

JBO-24(2)'19



www.emvisionllc.com

HW-Raman Guided Oral Cancer Surgery

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Eurostars-project: Ra-Sure (ESTAR18101)

300.000 new oral cancer patients/year

Surgery to remove tumour successful in only 15% of cases

Technology needed to support surgeon

RIVERD

Erasmus MC

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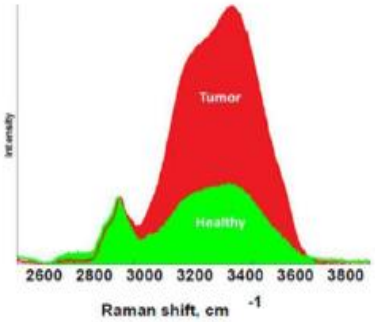

SurGuide

Improving Surgical Oncology

Product: MarginGuide - device & disposables

Worldwide market (oral cancer): 1500 hospitals * 100 procedures/yr

Introduction: 2021 (Europe)

Multi-Spectral Fiber System for Research

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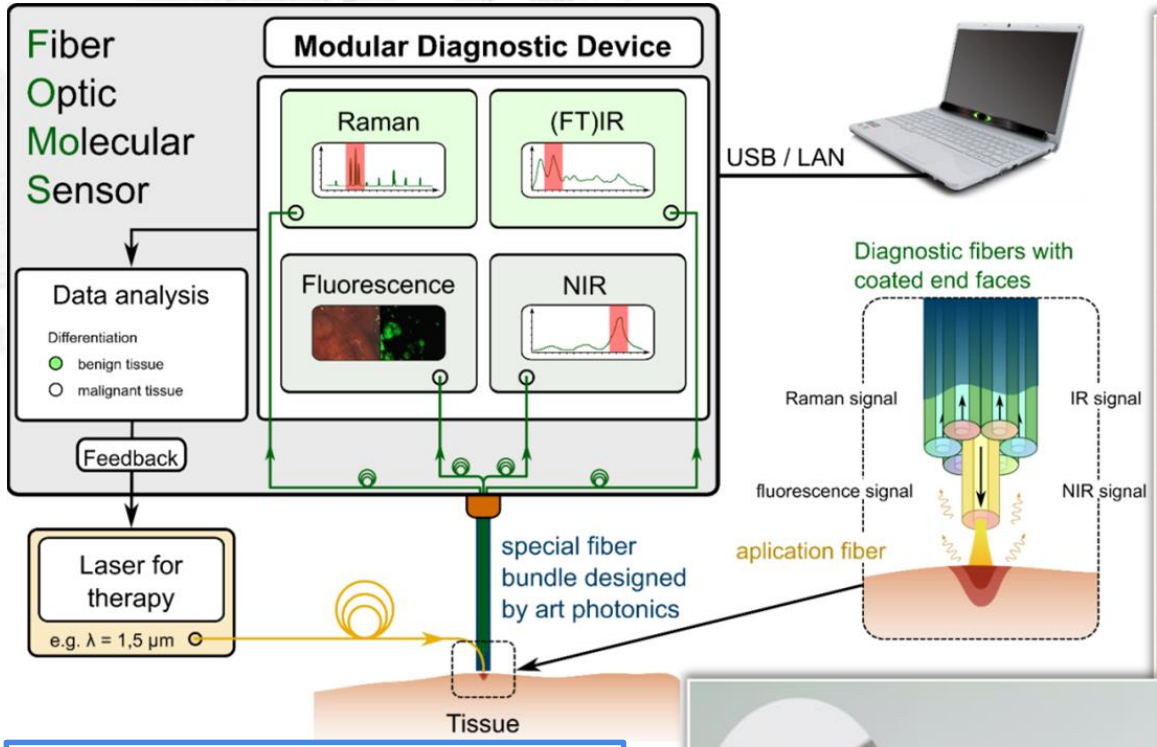
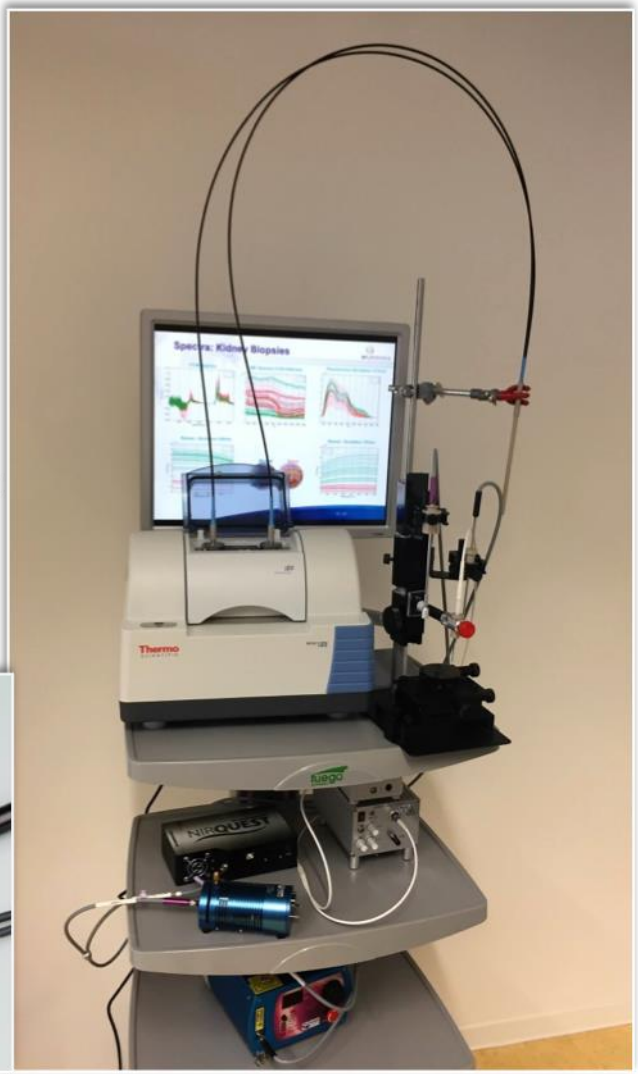
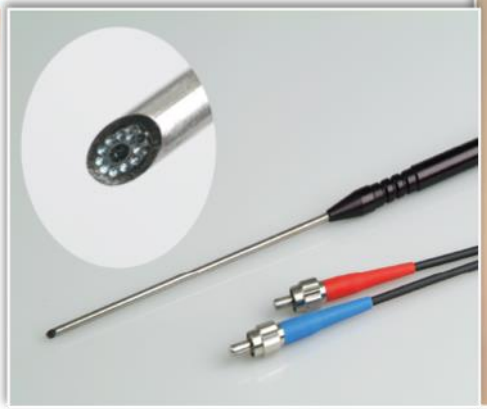


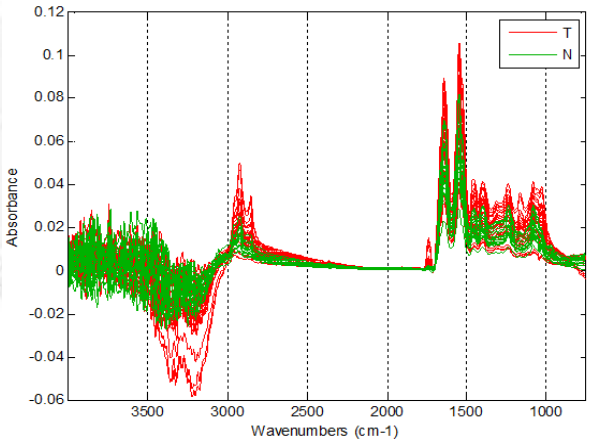


Raman Probes, OD=3mm & 1,5mm

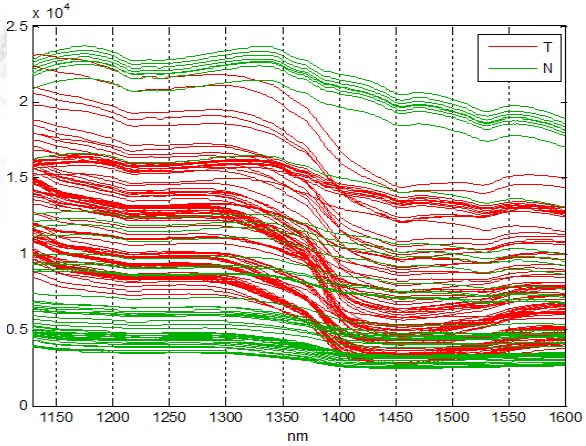


Spectra Measured for Kidney Cancer Biopsies

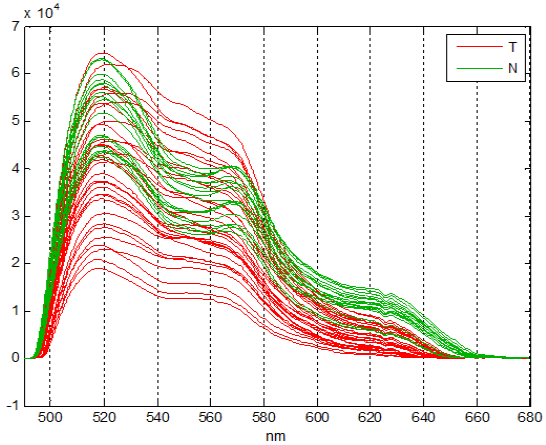
FT-IR-ATR-Absorption Spectra



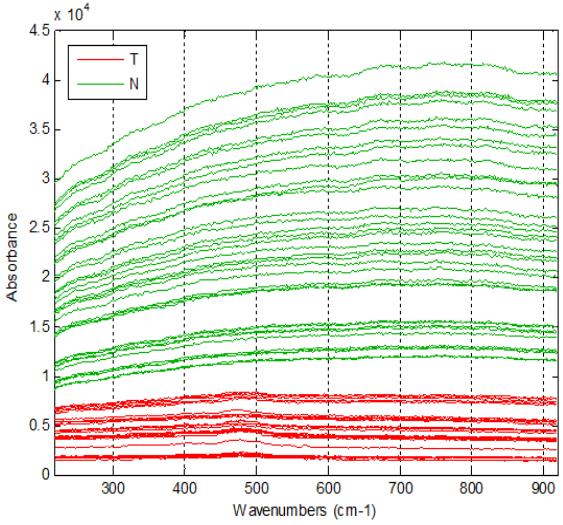
NIR Spectra (1129-1600 nm)

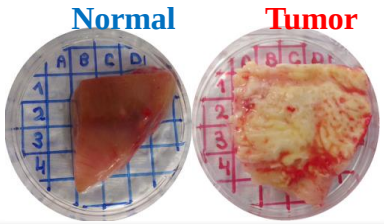


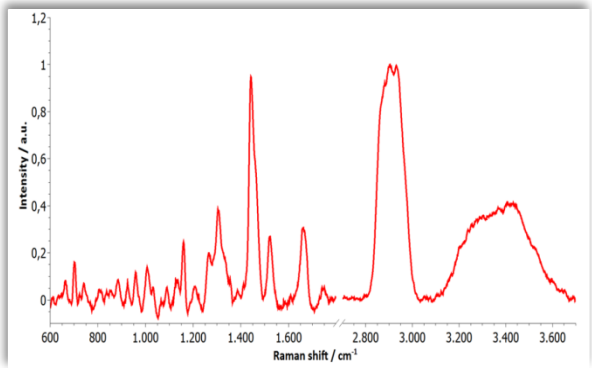
Fluorescence (Excitation 475nm)



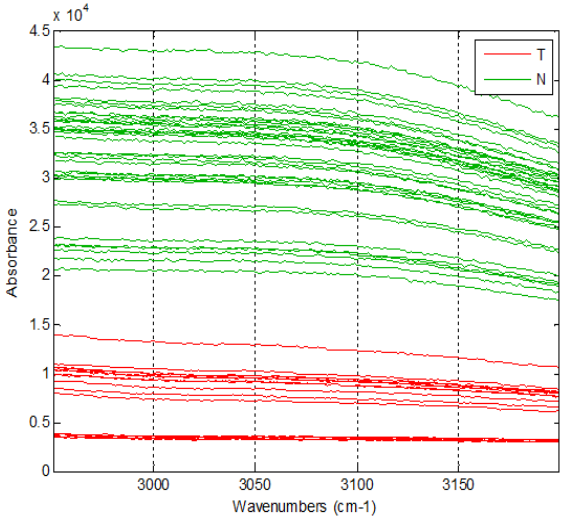
Raman - Excitation 785nm





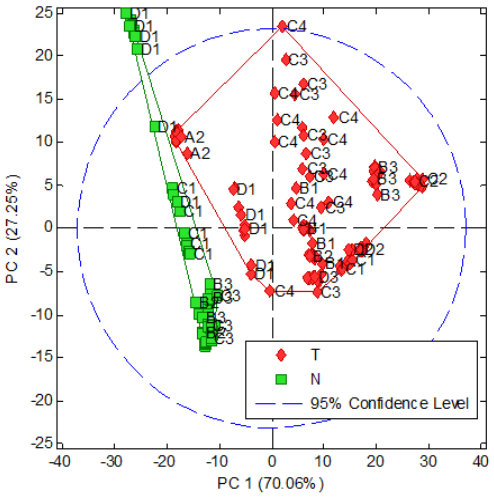


Raman - Excitation 690nm

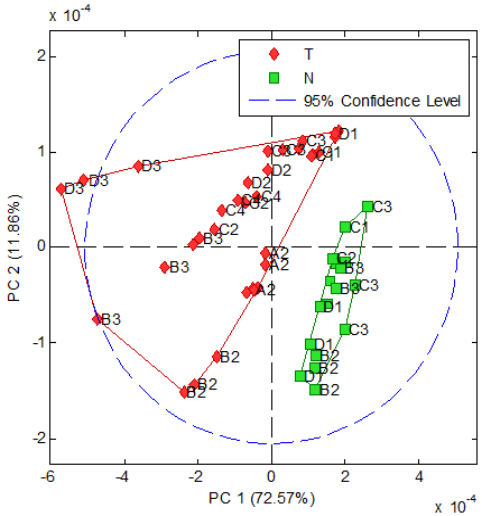


Chemometric Analysis for Spectra of Biopsies

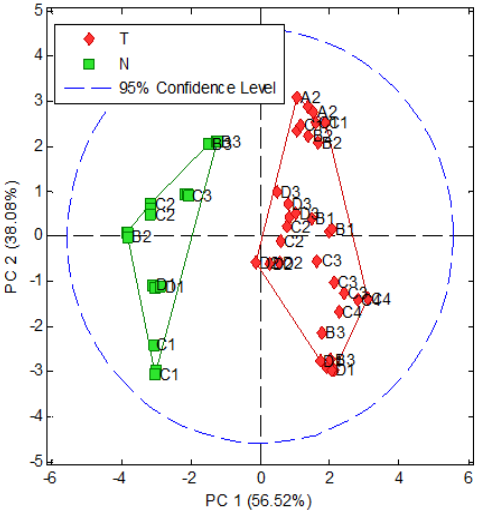
NIR-Spectra (1129-1600 nm)



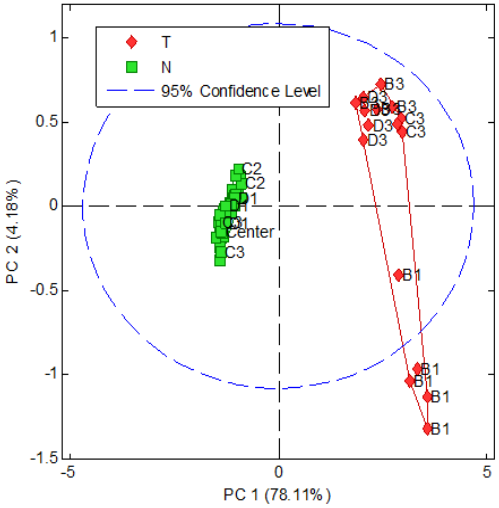
FT-IR-Spectra (1240-1040 cm^{-1})



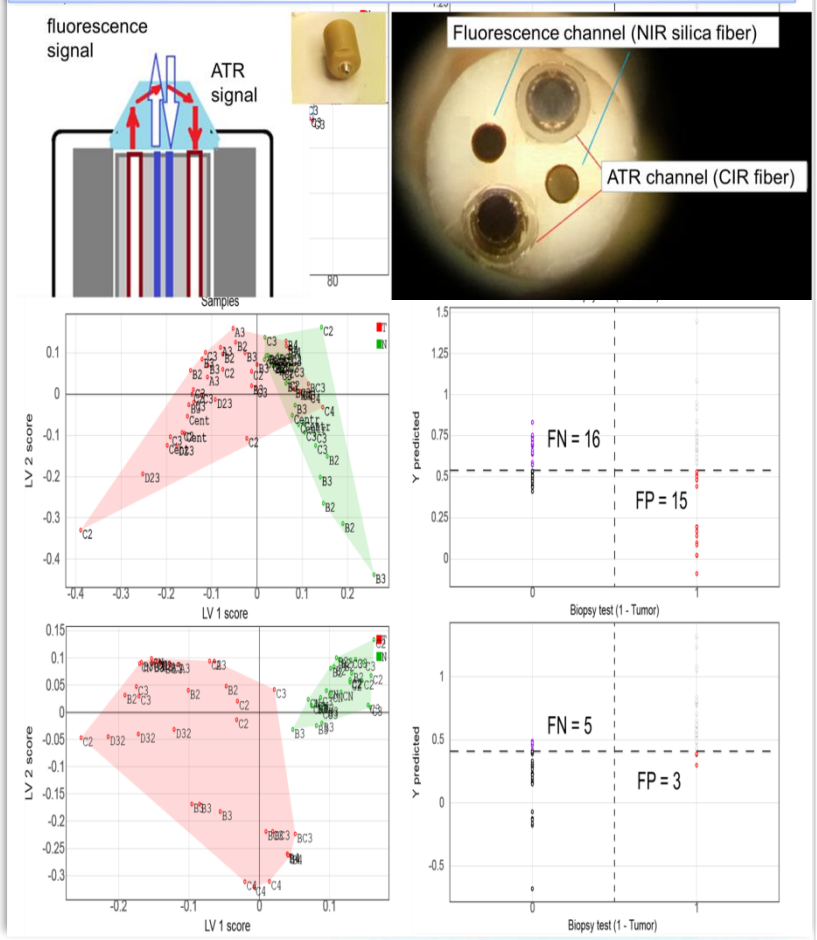
Fluorescence – 473nm



Raman – Excitation 690nm



Test for kidney RCC (79 spots) made with the 1st Combi-Fluo-/ - ATR-MIR-Absorption Probe



Fusion of Fluorescence with Mid IR-absorption spectra

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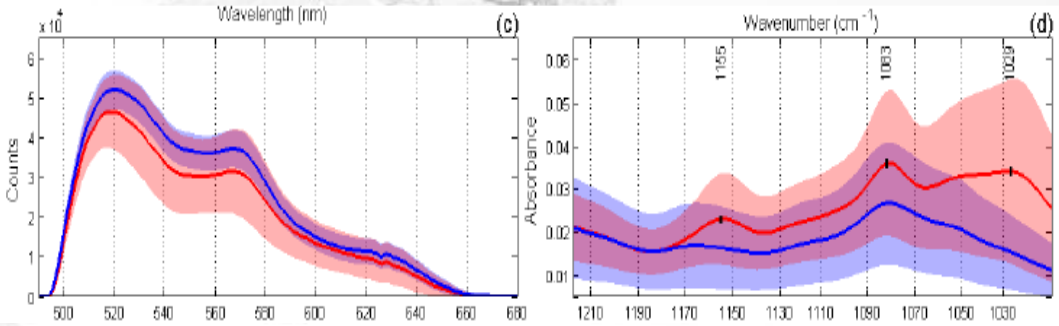
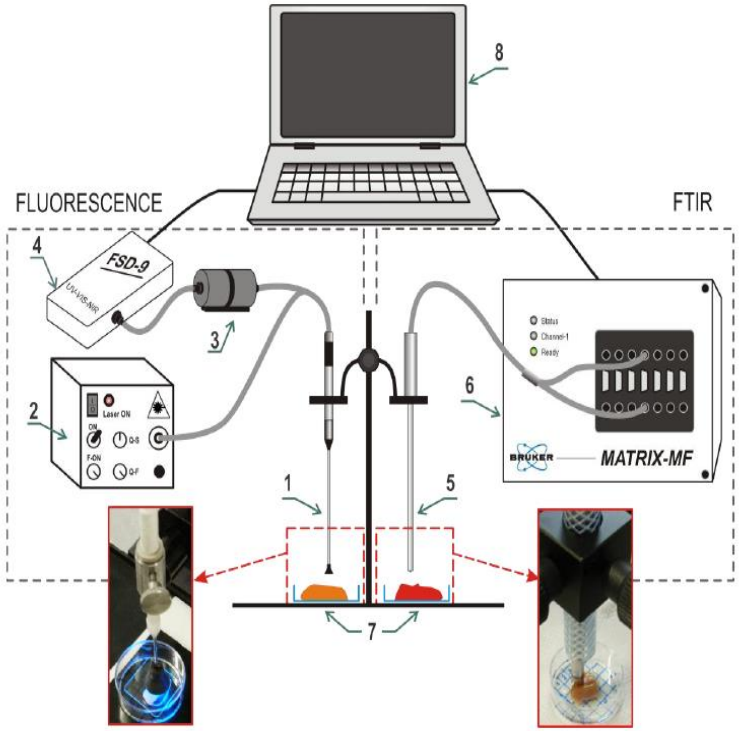
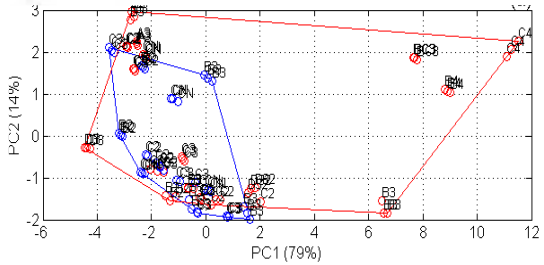


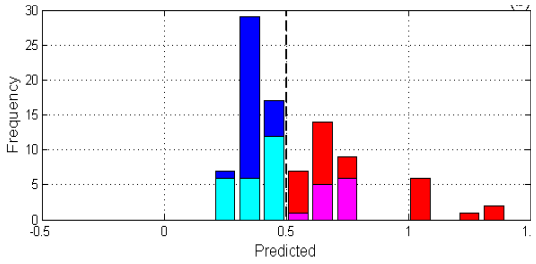
Renal Cell Carcinoma of kidney (*in-vitro*)

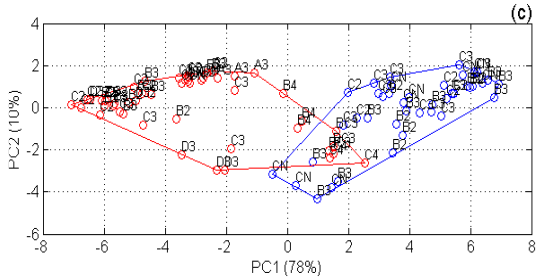


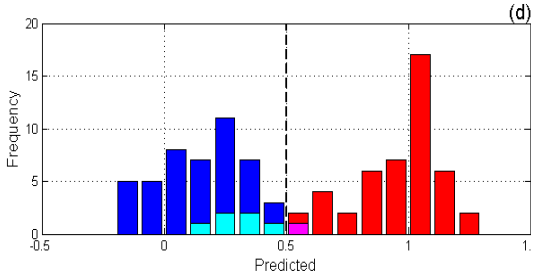
PCA

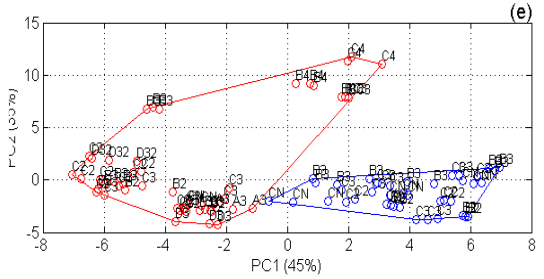


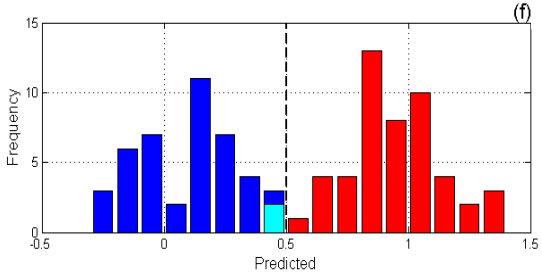
PLS-DA











Sensors **2017**, *17*, 2548;

Synergy of Fluorescence and Near-Infrared Spectroscopy in Detection of Colorectal Cancer

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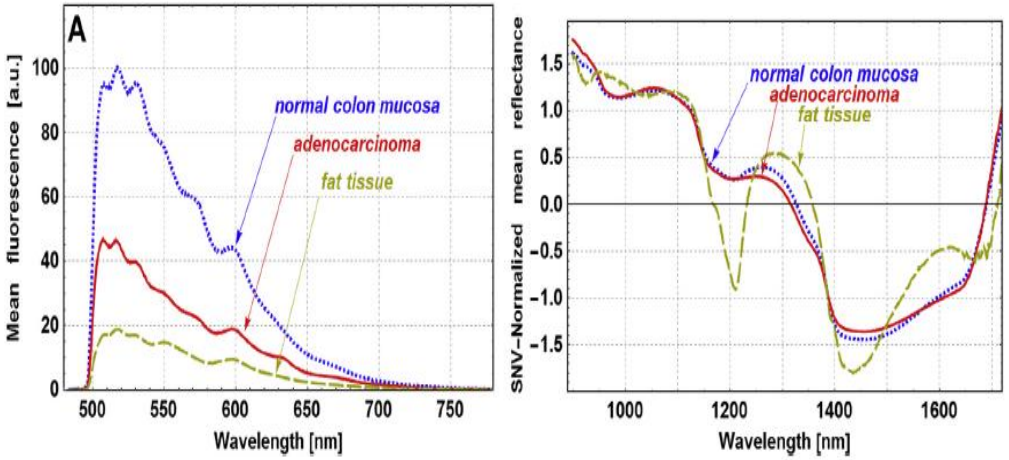

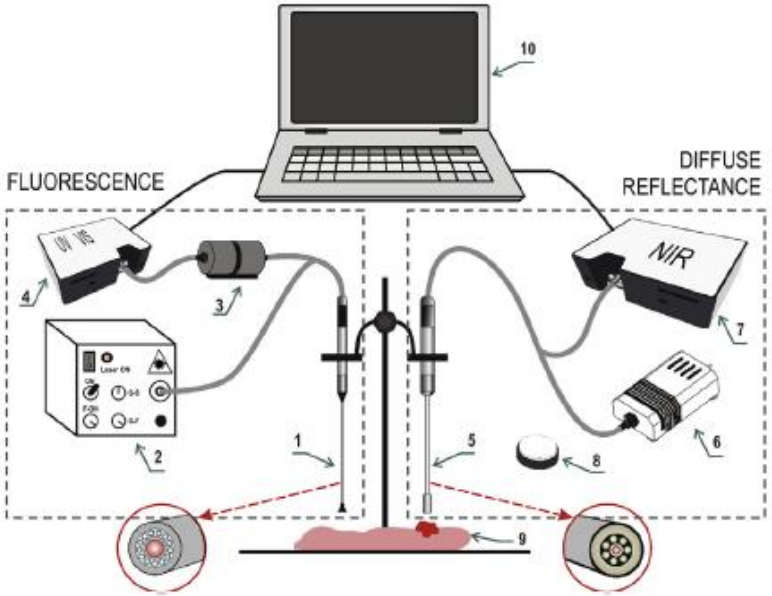

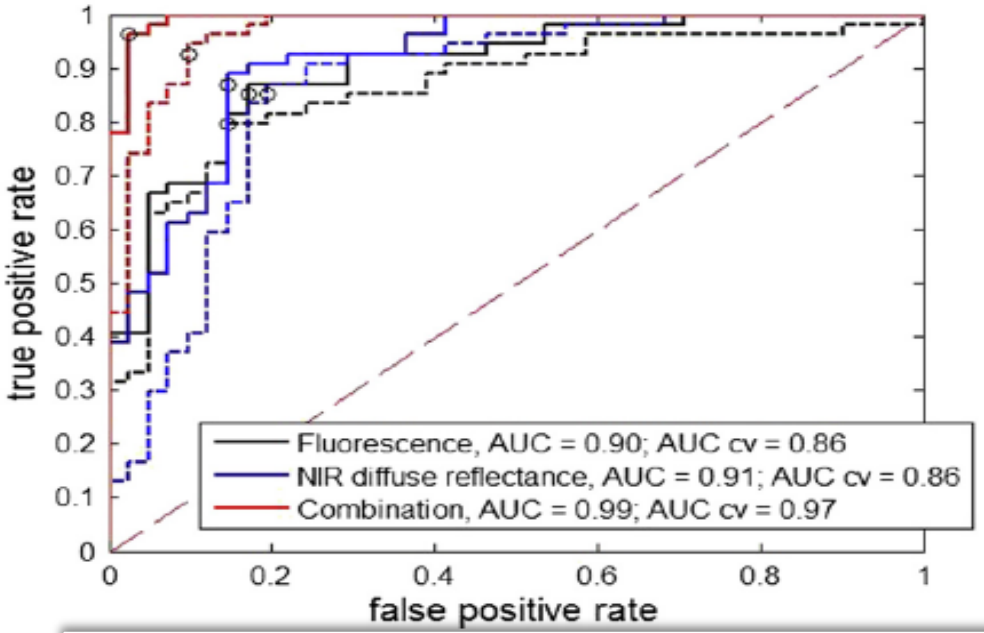

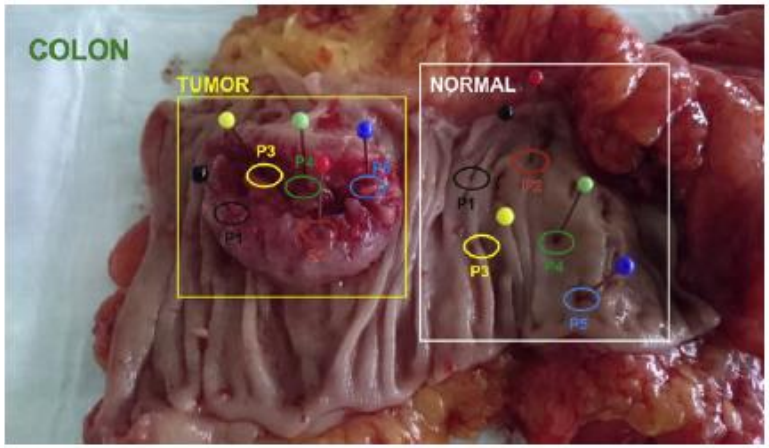

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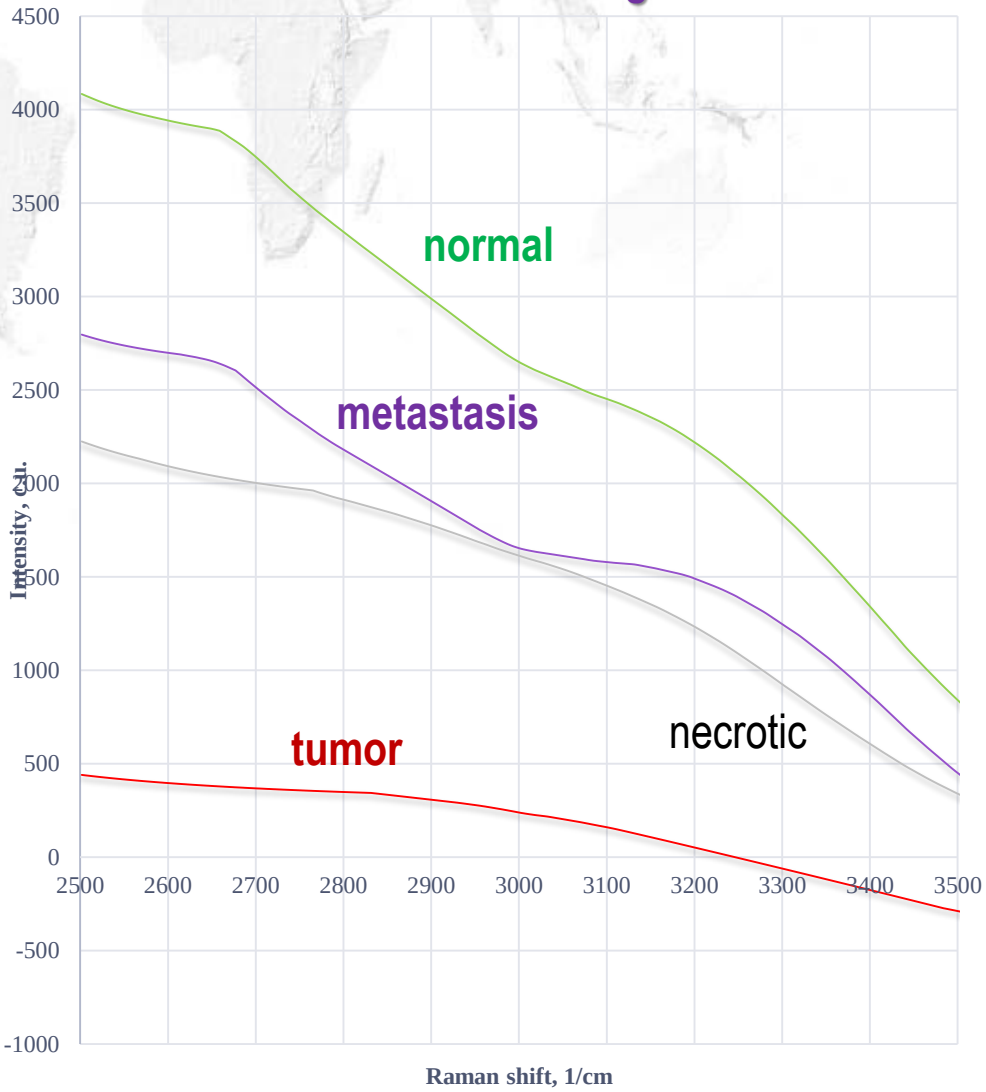
Auto-fluorescence background signal in tumor, normal, metastasis and necrotic tissue of Tongue Cancer



SCC-margins detected by Raman-HW (670nm) scattering method

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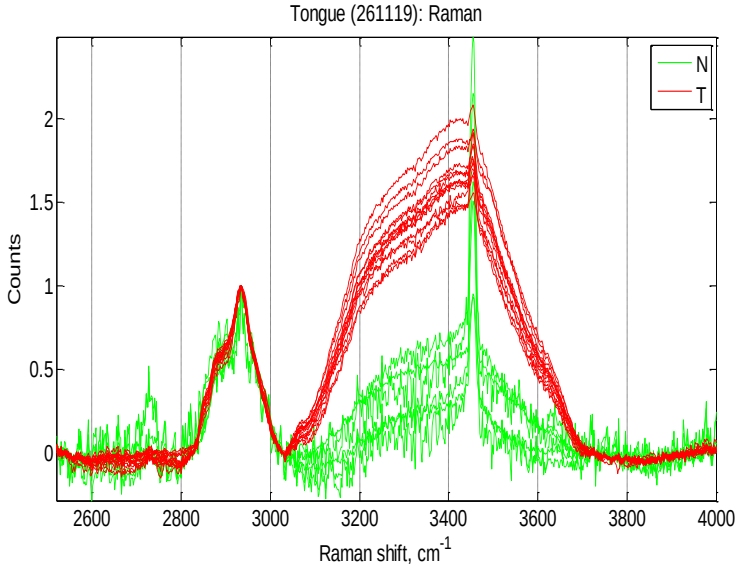

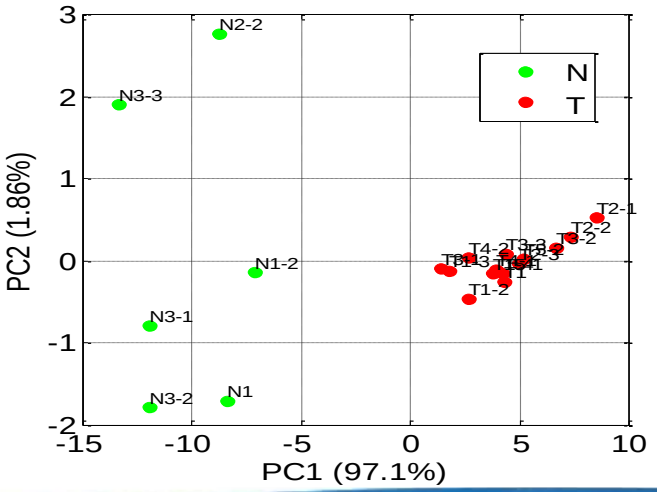

Tongue Tumor in NIR-DRS & MIR-Absorption

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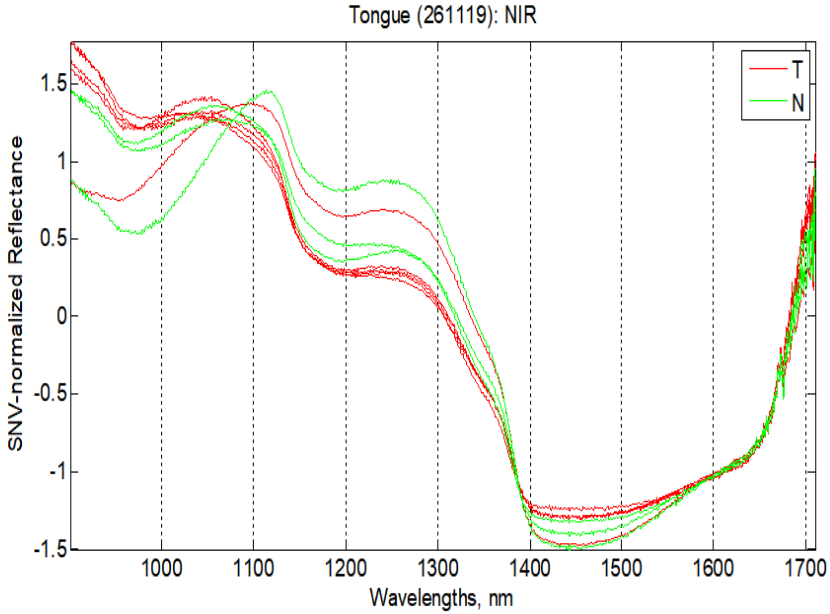

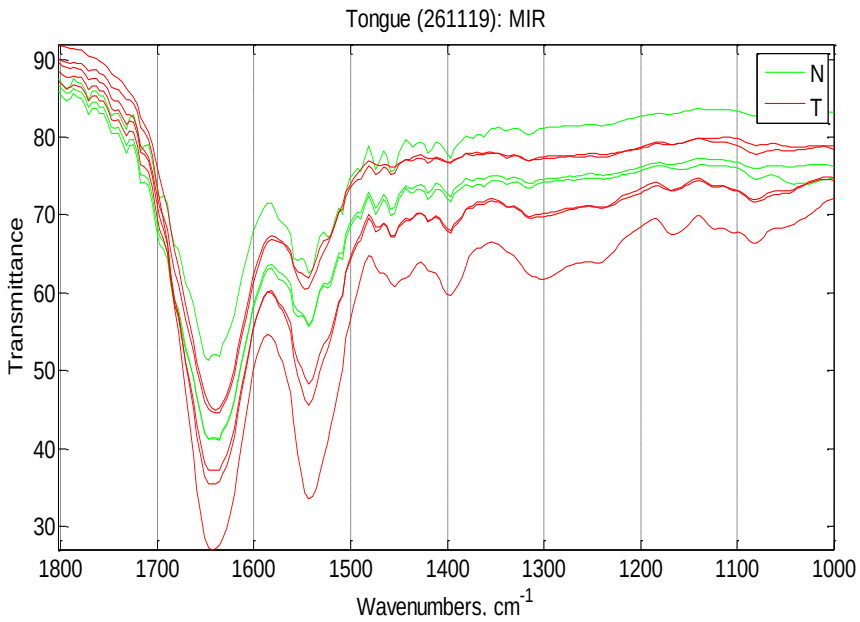

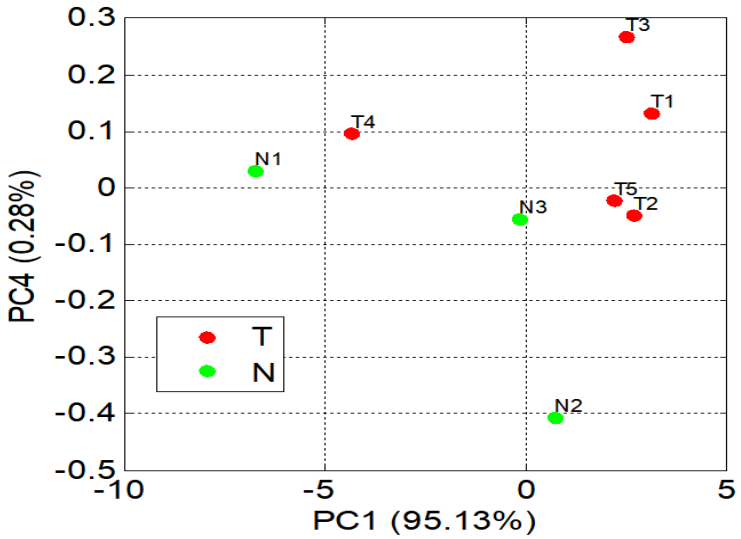

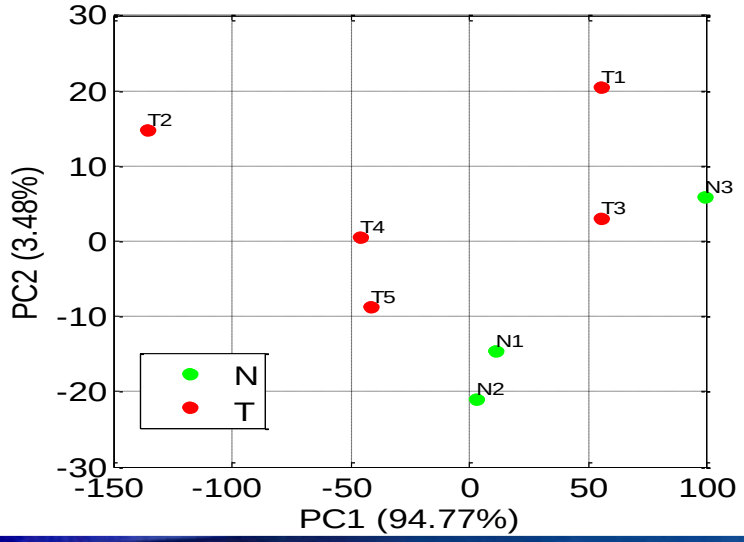

Concept of NIR-LED-sensor to Detect Renal Cell Carcinoma by NIR-DRS-Spectroscopy

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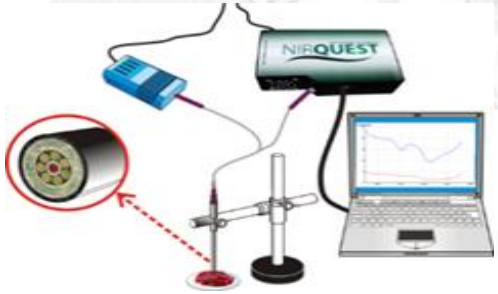

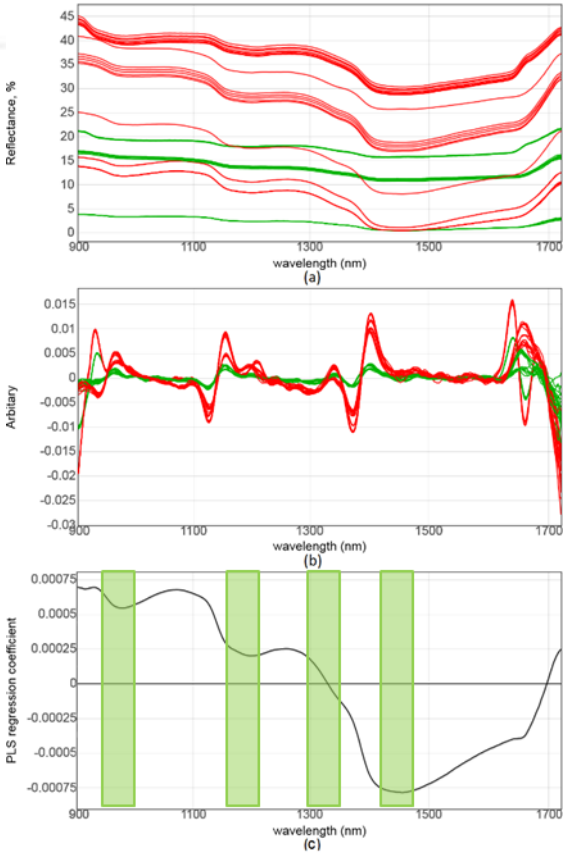

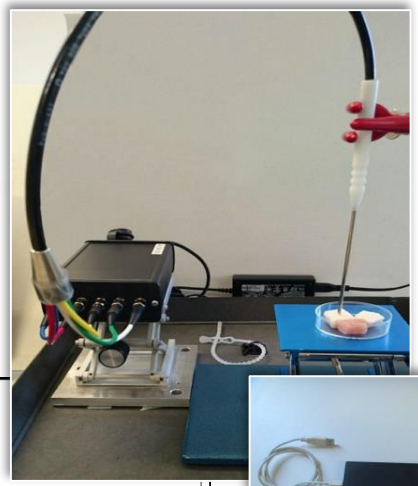

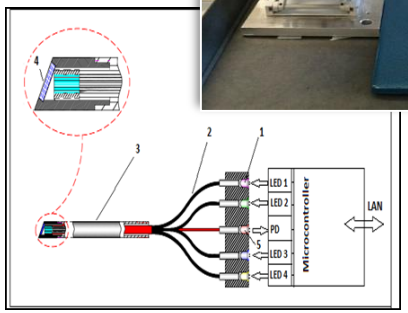

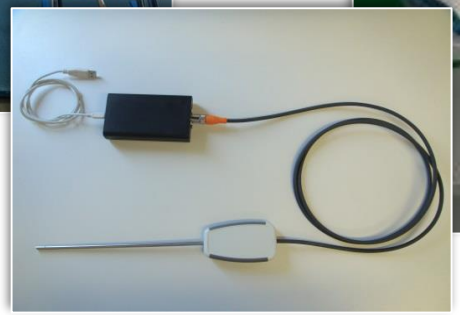

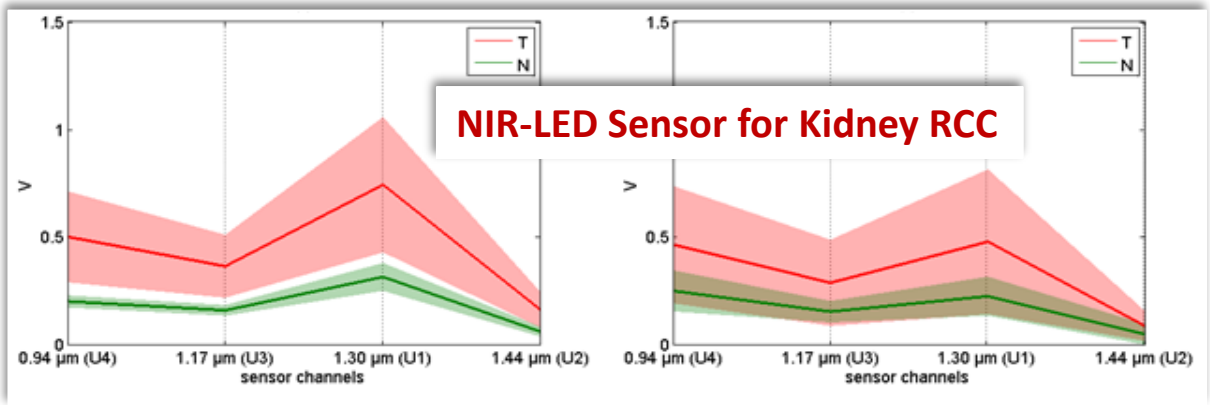

NIR-LED Sensor for Kidney RCC

Tumor Margin to detect with spectral method fusion and to upgrade it to IoT!

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This presentation was presented at
EPIC Meeting on Photonics for Cancer Diagnostics and Treatment 2019

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