

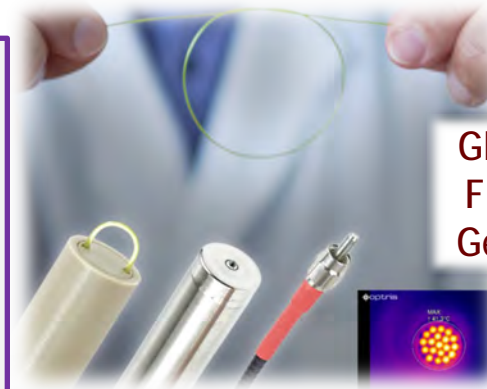
Mid IR-fiber solutions for Mid IR-Photonics

Viacheslav (Slava) Artyushenko



Key topics for Mid IR-Alliance:

- How to motivate OEM of components to integrate them in B2C systems?
- How to find the most promising B2C & B2B applications?
- Where Mid IR-systems are better to use vs UV-Vis-NIR devices or to combine them for the synergy effect?



Global Leaders in Mid-IR
Fibre Optics 2020 in the
German Business Award



*IR-fiber bundle combining
Quantum Cascade Lasers
in Spectral Fiber Sensor*



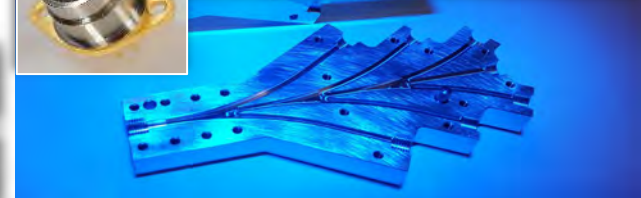
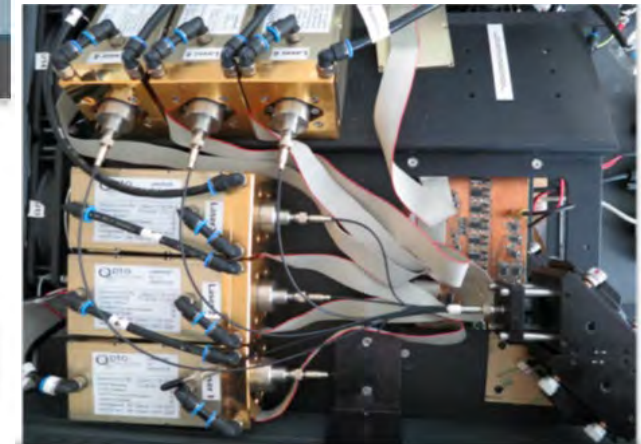
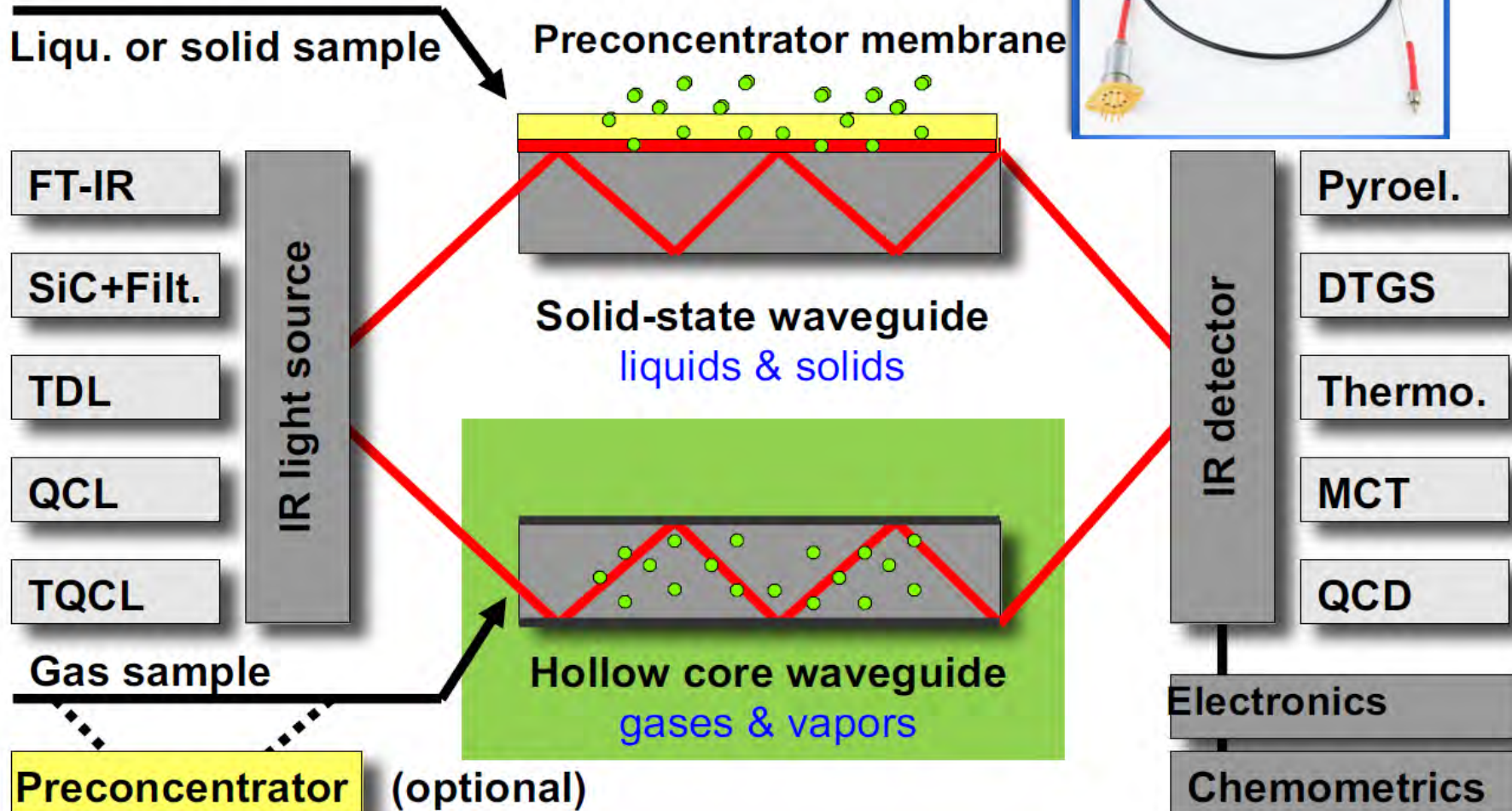
*Flexible cables for Er-, CO-
& CO2-laser power delivery by
IR-Fiber or Hollow Waveguide*

Monday, 21 February 2022, 15:00 - 17:00 CET
EPIC Online Technology Meeting on MidInfrared
Alliance Present and Future

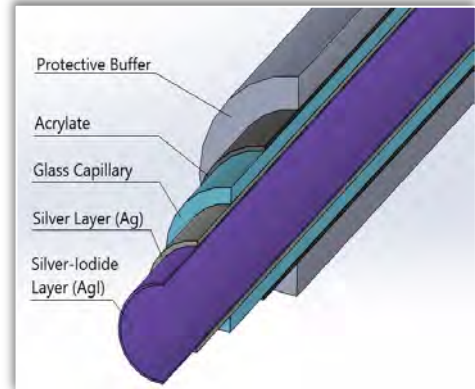
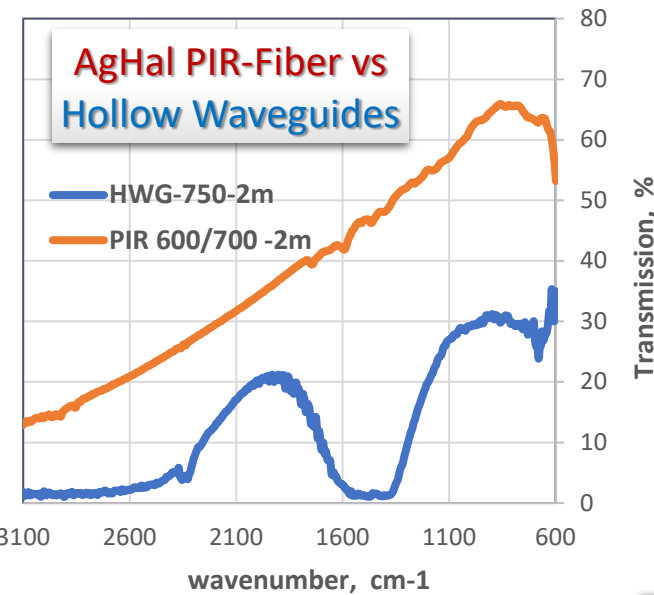
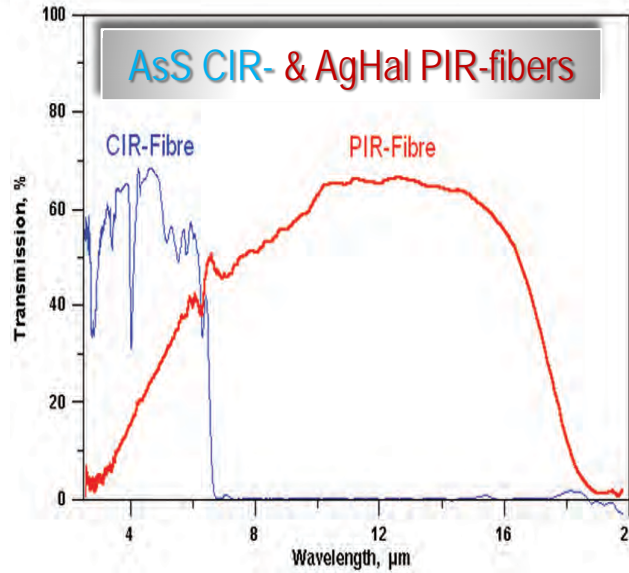
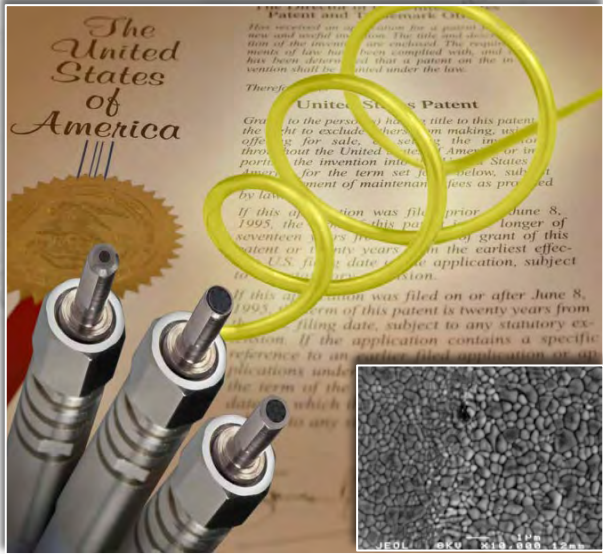
Coupling of Mid IR-components by Mid IR-fibers & Hollow Waveguides

Infrared Sensor Technology

IR devices developed at IABC

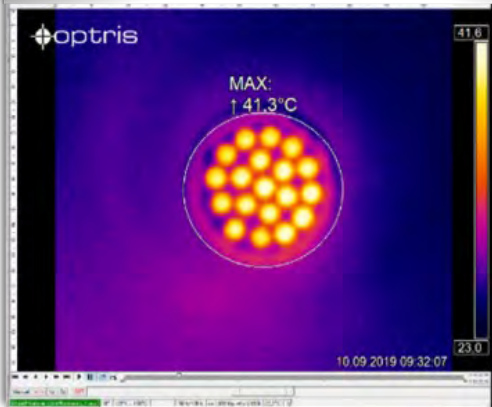


B. Mizalkoff, Chem. Soc. Rev., 42, 85

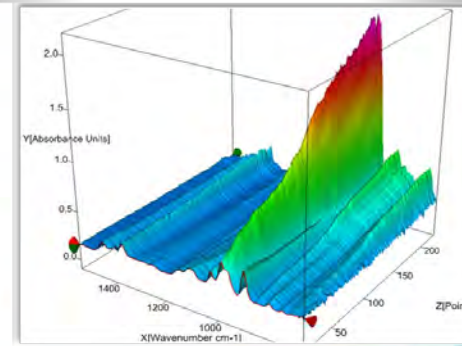


**PIR-Fiber & HWG
Cables for QCL, OPO,
CO- & CO2-Lasers**

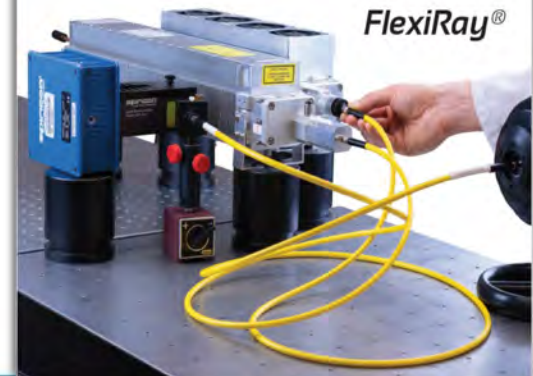
19xPIR-fiber IR-image bundle



**Fiber Probes for FTIR-
Process-Spectroscopy**



- The most flexible cables for CO- & CO₂-laser power delivery
- SMART-technology to suppress Fresnel reflection losses
- Stable transmission under small bending radius

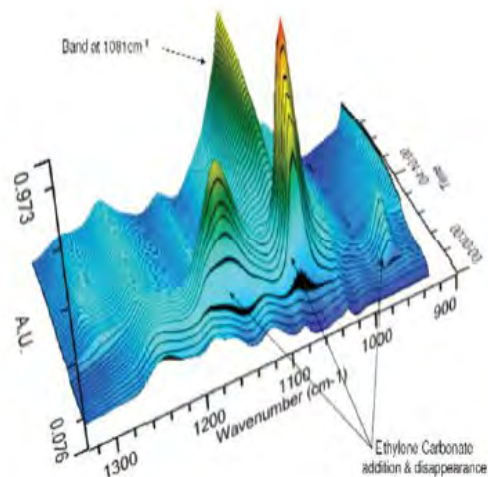




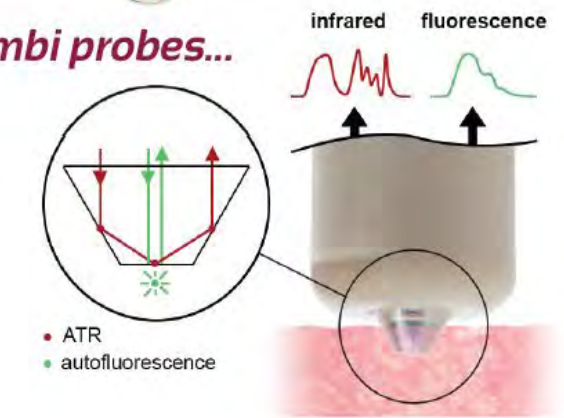
Multi-Wavelength Mid IR
QCL-Fiber Sensors



Fiber Probes for Multi-Spectral Process Control & Diagnostics in 0.3-16 μm range



and *combi probes...*

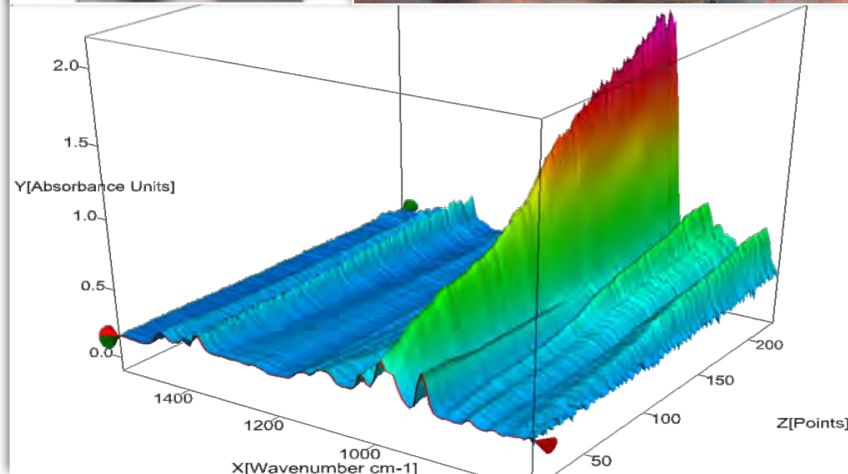


ATR-PIR-Fiber Probes for High Temperature PAT in Petrochemistry, SiS-ATR-Probes for Bio-Reactors and for Harsh Environment

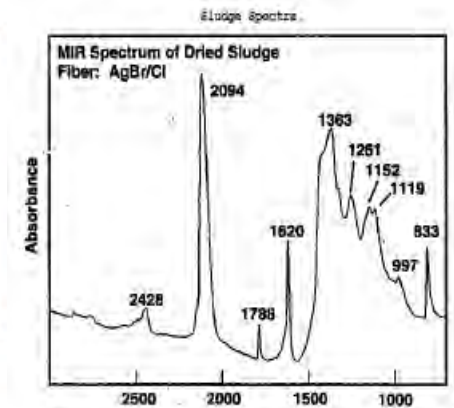
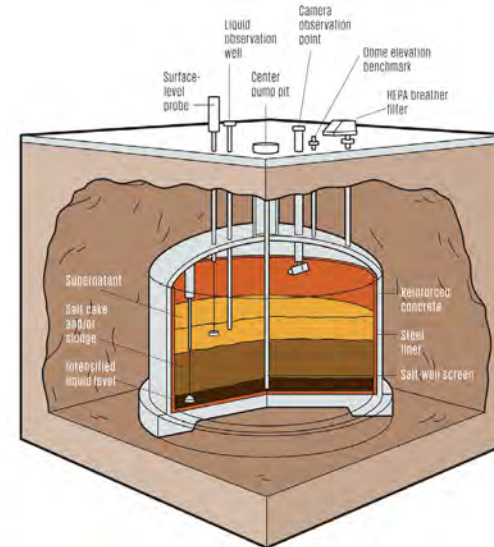
HT-ATR-Probe
(gas cooled) for
<250°C



Shaft-in-Shaft ATR-Probe
enables to sterilize Bioreactor
with detachable Shaft

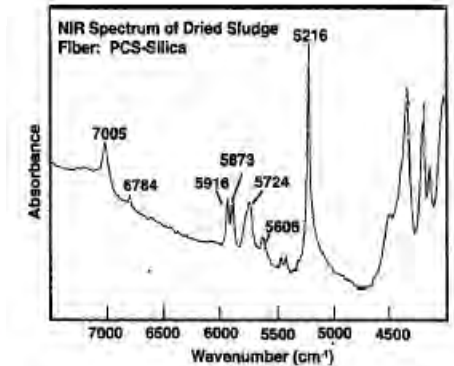


Double-Shell Tank for
Nuclear Waste deactivation



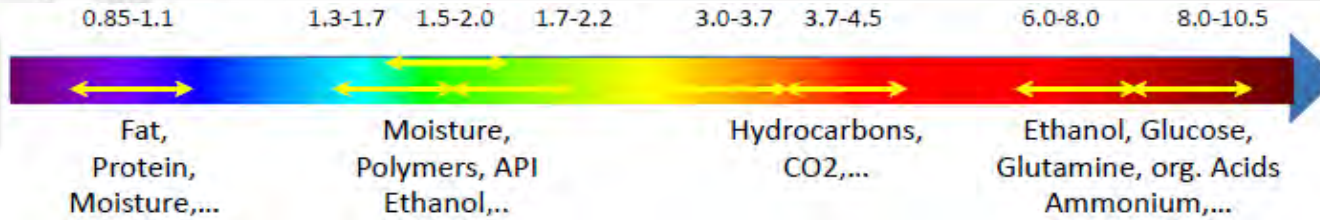
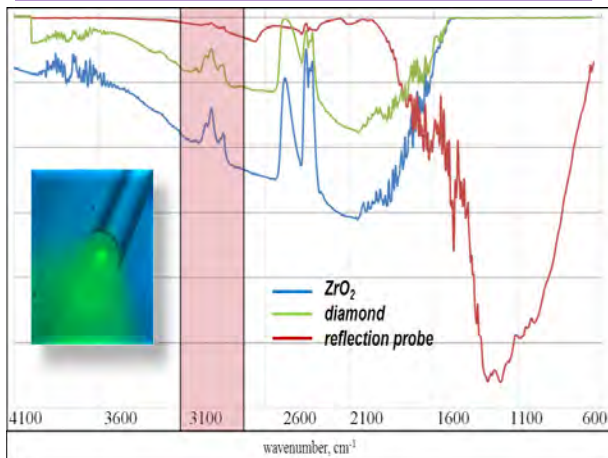
Constituent	Concentration, M
Na ₂ SO ₄	0.23
Na ₃ PO ₄	0.27
NaNO ₂	1.5
NaNO ₃	4.5
CsNO ₃	0.00013

Note: No radionuclides

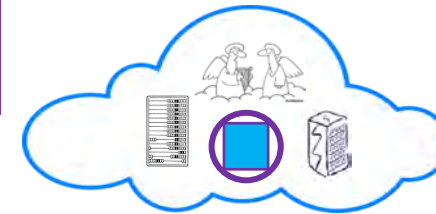


Monitoring of biofermentos & polutions with spectral fiber sensors

Monitoring of petrochemical pollutions in soil



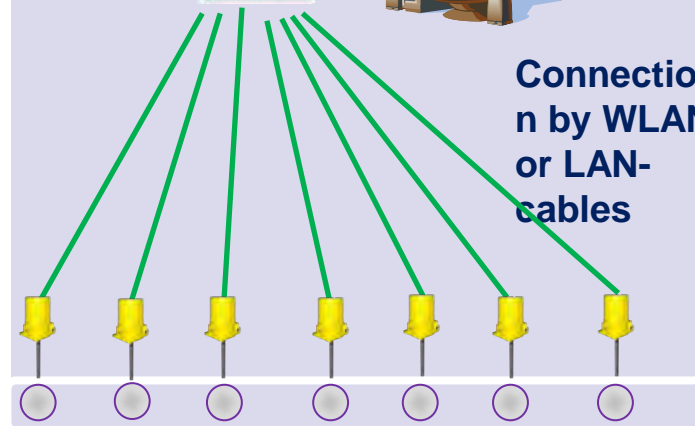
Sensors installed in measuring points and send results via wires, Ethernet, Wi-Fi, etc.



Control System

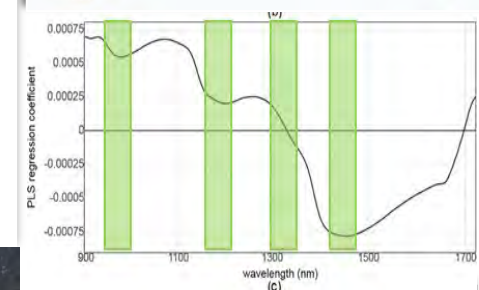
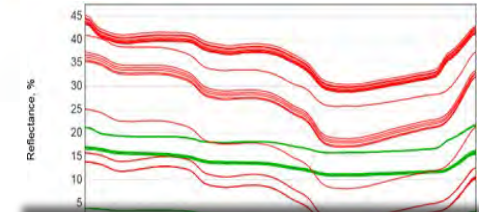


Connection by WLAN or LAN-cables



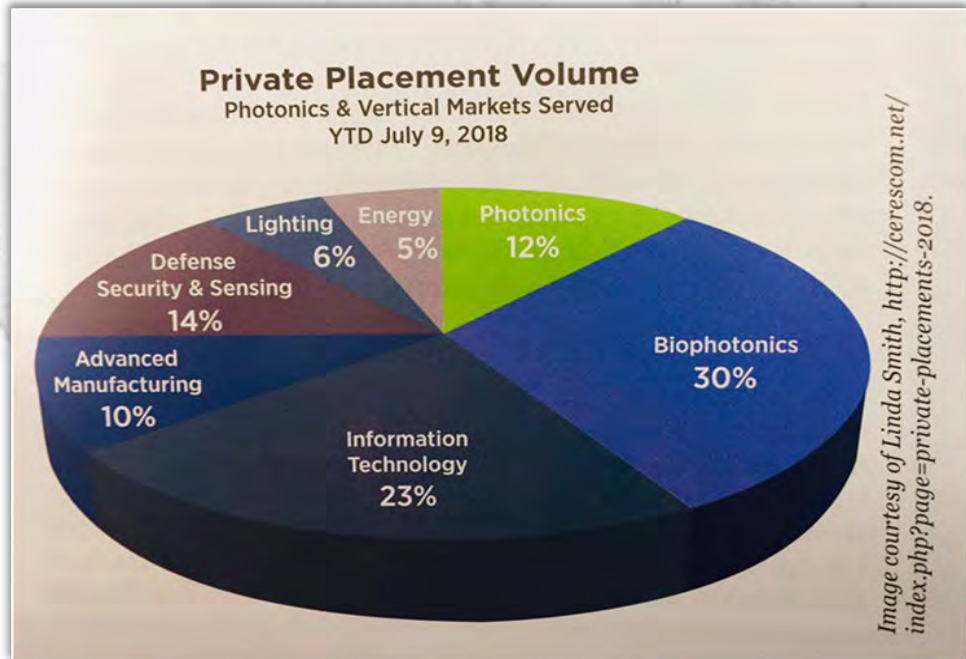
Various process points to monitor

Innovative IR-LED, QCL and Fabry-Perot tunable filters enable to develop compact spectral fiber sensors of customized design with data send to iCloud as in IoT - to enable **remote process control in customized applications**



Multi-Wavelength IR LED & QCL-Spectral Fiber Sensors

Market for Photonics Sensors & Detectors (\$ MILLIONS)



Application Type	2015	2016	2021	CAGR% 2016-2021
Military	2,709	3,051	5,694	13.3
Homeland security	980	1,126	2,279	15.1
Industrial process	739	861	1,868	16.8
Factory automation	623	730	1,635	17.5
Civil structure	645	740	1,498	15.1
Transportation	566	661	1,510	18
Biomedical	462	540	1,183	17
Microfluidics	412	483	1,084	17.5
Bio-environmental	260	309	737	19
Wind-energy turbines	226	269	648	19.2
Oil and gas	254	295	619	16
Others	174	204	445	16.9
TOTAL	8,050	9,269	19,200	15.7

➔ Spectral fiber sensors must be developed for customized applications in industrial process control – to be installed in critical points of reactor for low cost and *in-line* control of reagents composition. Sensors should transfer data by WiFi to iCloud for real time data treatment – to enable process control and its automatization matching the IoT & Industry4.0 concepts

