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PHOTONICS PUBLIC PRIVATE PARTNERSHIP

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreemant No 731778. The project is an initiative of the Photonics Public Private Partnership. www.photonics21.org

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WATERSPY

High sensitivity, portable photonic device for thorough water quality analysis

www.WaterSpy.eu

Challenges and Impact

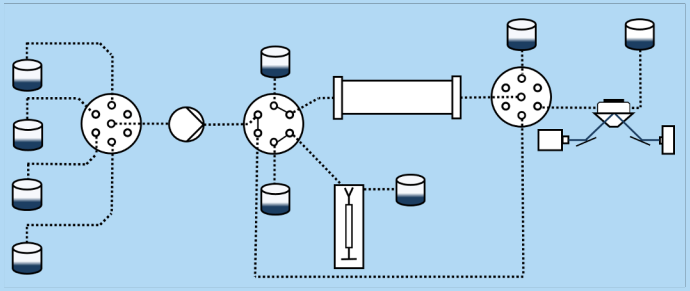
Pervasive and on-line water quality monitoring data is important for detecting contaminants in tap water, which could lead to human health hazards. Water utilities, public authorities and regulators rely heavily on frequent sampling and laboratory analysis. This is time-consuming and expensive. WaterSpy faces these issues by developing an add on device for currently available quality monitoring platforms.

Challenges:

- It's difficult to gather pervasive and on-line water quality monitoring data, including all contaminants mentioned in EU Directives on water quality. WaterSpy will focus on bacterial contamination. The bacteria strains, which are of special interest are E. coli, Salmonella and P. aeruginosa.
- The concentration of contaminants is very low and thus hard to detect.
- The device has to be compact, portable, energy-efficient and should perform measurements faster than currently available devices.
- The aspired solution is based on absorption spectroscopy beyond the 5 µm range. Unfortunately, water itself is a very strong absorber of infrared light and special techniques have to be applied.

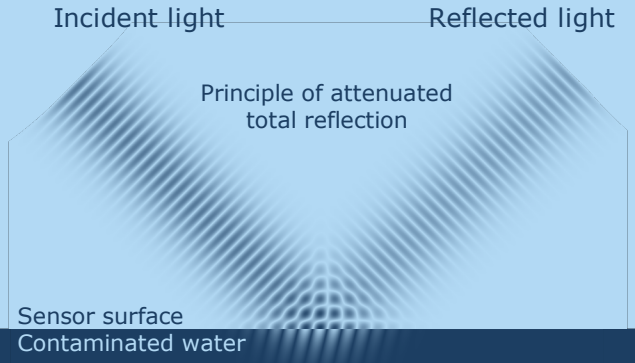
Impact:

The aquisition time of the WaterSpy device will be significantly lower than of current state-of-the-art devices. In combination with its high sensitivity and the compact size, the WaterSpy device will bring a step change in such applications.



Approach and Objectives

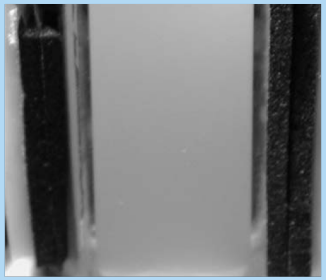
- Key Strategic Objectives:
  - Develop compact photonics technology, capable of identifying selected heterotrophic bacterial cells in the water. Specificity and sensitivity levels will respect regulatory requirements.
  - Validate the technology's cost-effectiveness and suitability for large area coverage.
- WaterSpy develops water quality analysis photonics technology suitable for inline field measurements operating in the mid-infrared region (6-10 µm).
- The solution is based on the combined use of advanced Quantum Cascade Lasers employing the Vernier effect and fast and sensitive Higher Operation Temperature (HOT) photodetectors.
- Targeted analytes will be specific heterotrophic bacterial cells. Several novel techniques are employed for increasing Signal-to-Noise Ratio.
- The device will require a couple of hours for a full sample analysis. With currently used systems, the same analysis could take up to 3 days.
- The WaterSpy technology will be integrated, for validation purposes, to a water quality monitoring platform, in the form of a portable device add-on.
- Towards the end of the project, the WaterSpy device will be tested at two pilot sites:
  - The Prato water treatment plant, which serves the city of Genova (approx. 580000 inhabitants).
  - The entry point of the Genova water distribution network.



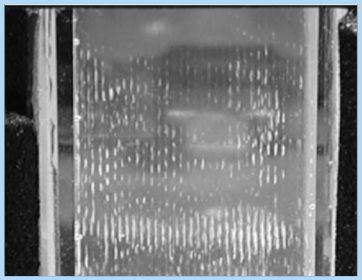
State and Achieved Goals

- Preliminary measurements with the bacteria strains of interest have been performed.
- An optical test setup using an ATR-cell (attenuated total reflection) has been done and first measurements are promising.
- Simulations on the optical setup gave hints for further improvements.
- Detailed concepts on the mechanics and microfluidics were developed (figure bottom left).

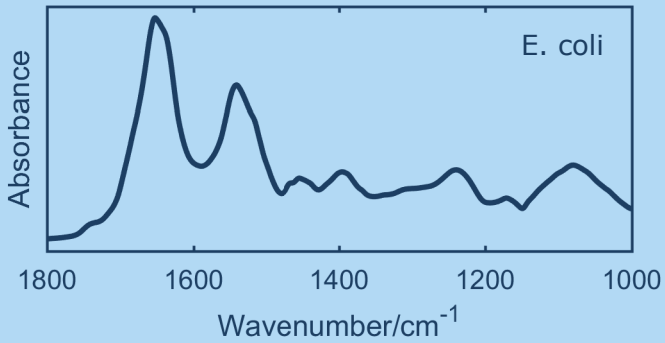
The figure below shows the concentrating effect of ultrasound on particles in a fluid. This technique will be used to pre-concentrate the bacteria and thus to increase sensitivity.
The figure bottom right shows some results of the preliminary measurements of the bacteria spectra using the principle of attenuated total reflection (figure bottom middle). This principle is preferable for highly absorbing samples like water in the mid IR region.



Ultrasound off



Ultrasound on



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