AQUARIUS

NEWSLETTER

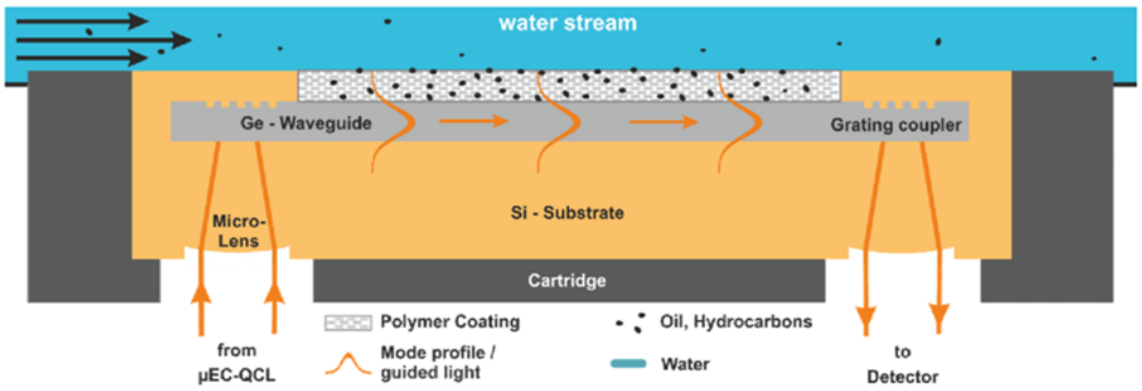
February 2018 - Issue 3

Message from the coordinator

With the third issue of the AQUARIUS newsletter we continue the series of technical reports that focus on the research undertaken within the project, by focussing on input from partner IMEC. The main task for IMEC in this project is the development of a silicon-based mid-IR photonic integrated circuit for in-line and on-line oil-in-water detection. In this issue, partner IMEC will provide more details on their ongoing work on integrated optical circuits to improve sensitivity of conventional ATR spectroscopic systems.

IN THIS ISSUE

Integrated optical circuits to improve sensitivity of conventional ATR spectroscopic systems.

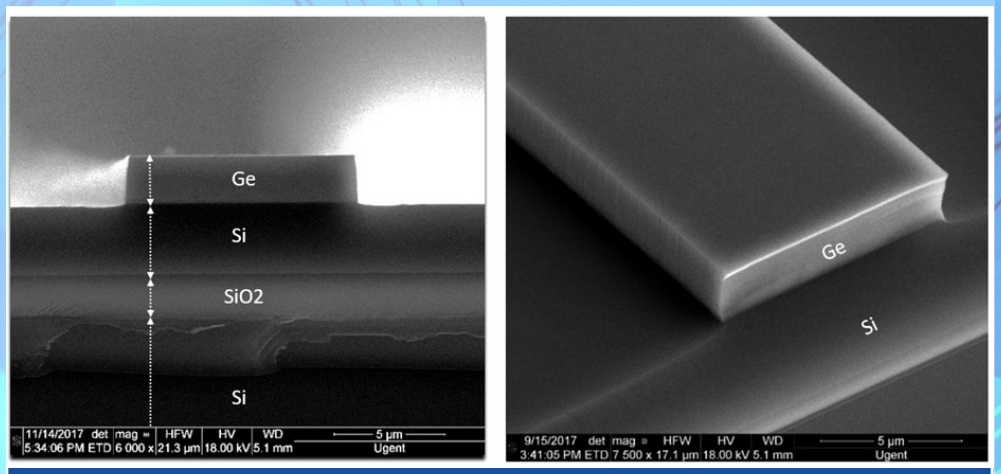


Schematic of the operational principle of the sensor for in-line monitoring.

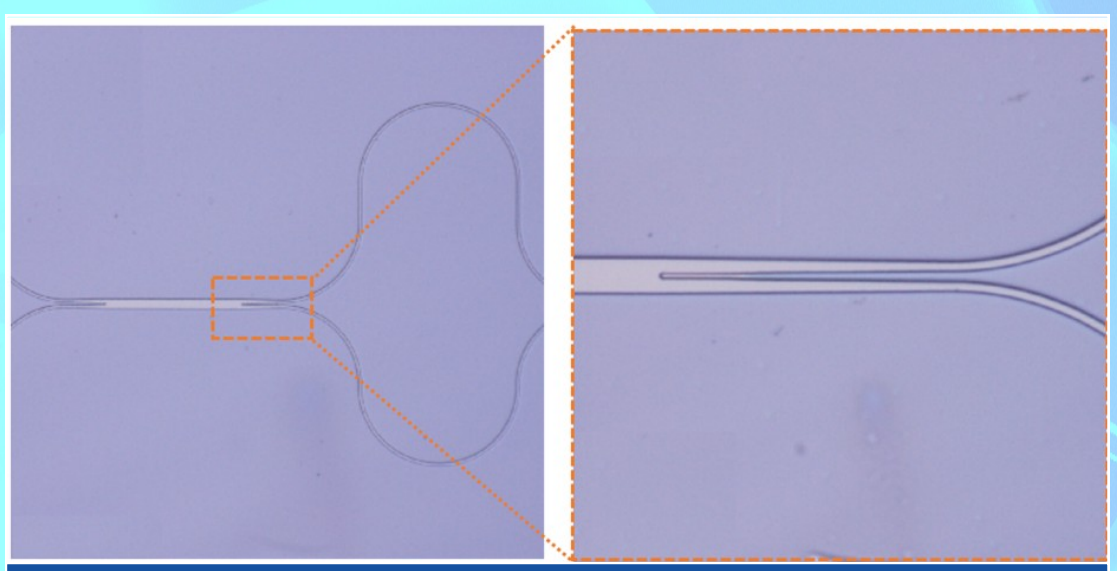
ATR spectroscopy is a well-known method to analyze liquid samples. However, the bulky nature of such systems limits the application range. Also, there is room for improvement in terms of sensitivity. In AQUARIUS these issues are tackled by realizing photonic integrated circuits. Photonic integrated circuits also have the advantage of wafer-scale manufacturing, thereby reducing the cost. This way, the PICs can be considered as disposable / interchangeable for the in-line monitoring of water.

The chips developed in AQUARIUS will be based on a Ge-on-SOI waveguide-based sensing platform which allows MIR spectroscopic detection owing to the transparency of Ge at the wavelengths of interest. The sensitivity of the sensors will greatly benefit from the increased light-analyte interaction length and the capability of in-situ referencing. In close collaboration with the project partners, the active sensor surface will be functionalized to further boost the sensitivity. Both the sensor itself and its packaging and interfacing will be tackled. Therefore, the required optical coupling structures (micro-optics, grating couplers, taper structures, …) will be integrated so that light can easily and efficiently be coupled in and out of the chip.

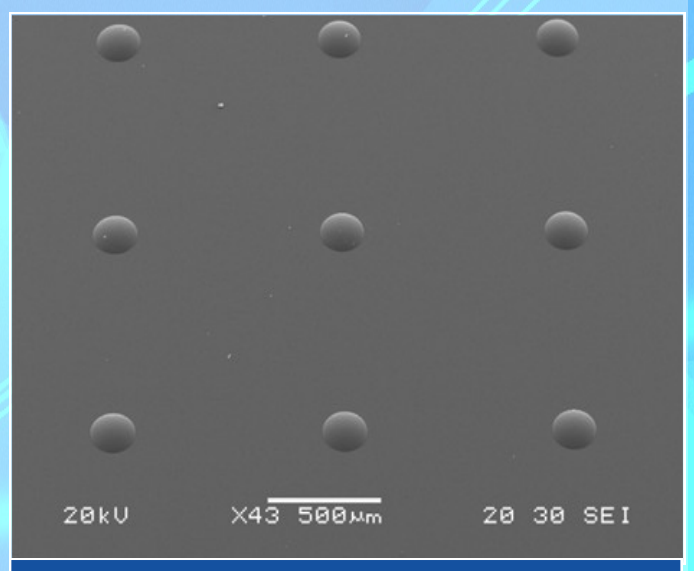
The multidisciplinary cutting-edge research required for the development of the AQUARIUS sensing platform will benefit the future development of similar sensors relying on the detection of molecules with spectroscopic signatures in the long-wave IR regime.



Cross-sectional views of fabricated waveguides.



Detail of fabricated waveguide structures for optical switching



Microlenses for efficient light coupling

Key Data:

Start Date:	1st January 2017	*Consortium:*	8 partners (5 countries)
End Date:	31st December 2019	*Project Coordinator:*	Dr. Klaus-Michael Koch
Duration:	36 months		coordination@aquarius-project.eu
Project Reference:	731465	*Technical Leader:*	DI Wolfgang Ritter
Project Budget:	€ 3.891.263,75		w.ritter@quantared.com
Project Funding:	€ 3.891.263,75	*Project Website:*	www.aquarius-project.eu

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The AQUARIUS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 731465.This project is an initiative of the Photonics Public Private Partnership.

AQUARIUS - BROADBAND TUNABLE QCL BASED SENSOR FOR ONLINE AND INLINE DETECTION OF CONTAMINANTS IN WATER

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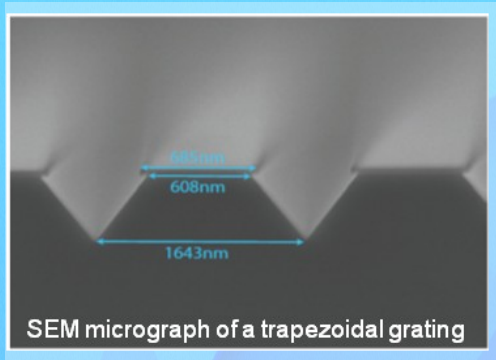
December meetings

From 12th to 13th of December, 2017, the **AQUARIUS Technical Meeting** at IMEC in Ghent/Belgium took place. The current project progress was discussed and upcoming work was defined. Moreover, the partners met to prepare for the **1st Review Meeting,** which took place on the 14th of December 2017 at the premises of the European Commission in Brussels. The team presented the current project results to the project offer of the European Commission and the external experts. The project officer and the external reviewers were impressed by the results shown and the very well managed project.

Review Meeting at EC premises in Brussels

Technical Meeting at IMEC premises Ghent

Technical progress since November 2017



SEM micrograph of a trapezoidal grating

For the online system different extraction concepts were tested with respect to the extraction efficiency. A testbed including electronics and software was set up that enables the automatic control of the method. Reference analysis was carried out with an adapted bench-top oil-in-water analyzer EraCheck (by QuantaRed Technologies). For the MOEMS module of **Mid-IR laser source,** grating scanners are optimized for the AQUARIUS wavelength range. Further, new parameter options of gratings dynamics are available and static MOEMS grating for slow wavelength tuning/static operation is employed. Fabrication of adapted MOEMS gratings is ongoing and the next devices are expected soon. **As far as the Broadband MIR laser spectrometer** is concerned, Mechanical design of the spectrometer was proposed and agreed with partners. Parts are now fabricated. Detection modules based on PIP preamplifiers and new designs were integrated and tested. Newly designed preamplifier has mechanics designed especially for this project. Digital acquisition submodule was assembled and firmware is being developed.

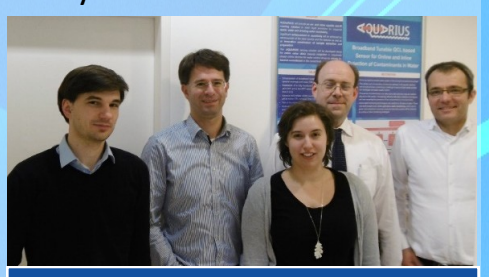
3D –printed model of a current light source prototype

Meetings with Advisory Board Members

The first Advisory board meeting was held with Professor Rudolph Kessler, on the 7th of November, 2017. The meeting took place at the premises of Fachhochschule Tulln and project partners QuantaRed Technologies and TU Wien introduced the project and presented preliminary results. The presentations were followed by a fruitful discussion with **Prof. Kessler**, who, due to his rich experience in the field of process analytics, could give many hints and tips for further technological steps. On the 12th of January, the AQUARIUS project was represented by partners QuantaRed Technologies and TU Wien, in a meeting with Advisory board member **Dr. Martin Mayer** from Siemens AG. Several topics in the field of water analysis were discussed and focus was set to the development of new online and inline oil in water analysis systems for the monitoring of industrial process water streams. Siemens AG has experience in delivering water treatment systems world-wide Based on this background several technical tasks were discussed. The next week, on the 19th of January, AQUARIUS representatives met Dr Martin Kraft from Carinthian Tech Research. Dr Kraft has outstanding expertise in photonics system integration and supported the AQUARIUS project with his experience from several projects. Project partners QuantaRed Technologies and TU Wien were present for AQUARIUS. The meeting focused on the spectrometer sub-system as well as on the integration into the new online and inline oil in water analysis systems for the monitoring of industrial process water streams.

Meeting with Prof Kessler

Meeting with Dr Martin Mayer



Meeting with Dr Martin Kraft

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