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

NEWSLETTER

May 2017—Issue 1

Main Project Information

AQUARIUS aims to provide an on- and inline capable mid-IR sensing solution to meet legal provisions for industrial waste water and drinking water monitoring. Significant enhancement in sensitivity will be achieved by further advancement of the laser source and the detector as well as an innovative combination of sample extraction and preparation with polymer functionalized waveguides. The **AQUARIUS** sensing solution will be developed along the entire value chain towards integration in industrially proven online devices for water control driven by strong industrial commitment in this consortium.

Objectives

- **OBJECTIVE 1:** Enhancement of broadband tunable quantum cascade lasers in terms of spectral coverage and noise (TRL increase: from 4 to 6)
- **OBJECTIVE 2:** Realisation of a fully functional spectrometer sub-system consisting of a µEC-QCL and a fast MCT detector including data acquisition (TRL increase: from 3 to 6)
- **OBJECTIVE 3:** Advance Oil-in-Water (OiW) monitoring capabilities from offline (state-of-the-art) to online (TRL increase: from 3 to 6)
- **OBJECTIVE 4:** Test of the online OiW system at industrial end users (TRL 7)
- **OBJECTIVE 5:** Realisation of integrated optical circuits (IOCs) for waveguide based sensing and inline capable sensing configuration (TRL increase: from 2 to 4)
- **OBJECTIVE 6:** Assembly and test of the inline OiW system in a laboratory environment (TRL increase: from 2 to 4)

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Message from the Coordinator

The intention of this Newsletter is to open a new communication channel in order to provide news on the project progress and to discuss ongoing topics relevant to AQUARIUS for internal and external project partners, stakeholders and all other interested bodies. For more detailed information about and around the project we warmly invite you to have a look on our project website, which is constantly kept up-to-date with the latest project related news: **www.aquarius-project.eu**. Hosted by OMV in Vienna, the project has successfully started with the Kick-off meeting in January 2017, and since then the project has been in its initial stages of formation. The AQUARIUS consortium consists of 8 partners from 5 different countries. Due to excellent cooperation in the proposal creation the basis for a very promising collaboration has already been set.

Technical Approach

The **AQUARIUS** project is planned to run for 36 months and is subdivided into eight work packages (WP). Between those work packages there are significant dependencies and expected synergies.

WP1 "Requirements and specifications for Online and Inline OiW analyser" is a foundation point for AQUARIUS execution. The main objective is to derive requirement definitions and specifications for the system, as well as sub-systems and modules. **WP2** "**Broadband tunable MIR laser source for spectroscopy"** will provide a miniaturized mid-infrared quantum cascade laser (QCL) module based on an external cavity scheme. The spectral coverage of the laser will be optimized for OiW detection. The focus of this WP will be the design, growth and processing of quantum cascade lasers and optical components for fast spectral scanning within the mid-infrared range. **WP3 "Broadband MIR laser spectrometer "**covers the development of a high-speed mid-infrared spectrometer for transmission and attenuated total reflection spectroscopy of OiW samples. The spectrometer will combine the QCL developed in WP2, an ultra-sensitive MCT detector and further components which are necessary to synchronize the laser operation and enable high-speed spectral scans. In **WP4** "**Inline OiW spectroscopy with functionalized sensor"** a compact demonstrator of a sensing system for fast and direct (inline) mid-IR spectroscopic measurement of liquids shall be developed and optimized for determination of the parameter OiW. In **WP5** "**Online OiW analyser by automatic extractor for hydrocarbons in water"** a system for enhanced online OiW analysis will be designed and developed towards a concept prototype. This task will comprise both, the development of new modules, i.e. an online extractor module and an online transmission spectroscopy module, and the integration of these modules with the broadband MIR laser spectrometer sub-system from WP3 into the final online OiW analyser. **WP6** "**Validation and assessment of MIR water analysers"** will perform validation and assessment of the online and inline OiW analysers. The systems will be tested against the requirement definitions from WP1. This will be done at different stages of development, after availability of the extraction module and with the final analyser systems. **WP7 "Dissemination, communication, Exploitation and Standardisation"** obtains input from other WPs, focusing on scientific research and ensures the communication and dissemination of results achieved within the single WPs to the outside parties, as well as to participating entities. WP7 will further support the partners to exploit the achieved results and impact the European and international market. The ethical and societal impact of the project will be closely monitored and reported on. **WP8 "Project, Risk and Innovation Management"** will interact with all other WPs in order to ensure a successful project lifetime with respect to risk and innovation management. WP8 shows dependencies to all other WPs, as it coordinates and ensures that the tasks are in line with the project work plan. Furthermore it performs scientific coordination as well, in order to reach the common goal of AQUARIUS.

Key Data:

Start Date:	1st January 2017
End Date:	31st December 2019
Duration:	36 months
Project Reference:	731465
Project Budget:	€ 3.891.263,75
Project Funding:	€ 3.891.263,75

Consortium: 8 partners (5 countries)
Project Coordinator: Dr. Klaus-Michael Koch
coordination@aquarius-project.eu
Technical Leader: DI Wolfgang Ritter
w.ritter@quantared.com
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.

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Kick-Off Meeting in Vienna, Austria

From **17th until 18th of January 2017** the **Kick-Off meeting** for the **AQUARIUS** project took place in Vienna. The event was compiled by TECHNIKON , with the main purpose of getting to know each other in order to strengthen further collaborations. Hence, part of the agenda was the introduction of all the partners involved. In addition to that, the presentation of the work packages, including technical discussions with a special focus on the deliverables due within the first 6 months, took place. Plans for the next steps within the project were made and finally the AQUARIUS project was officially launched.

UPCOMING EVENTS

- 26 -28 June 2017: **ASTM D19 Meeting "Water"** Denver, CO, USA
- 05 -06 July 2017: **AQUARIUS Technical Meeting**, Freiburg, DE
- 23-25 October 2017: **7. MikroSystemTechnik Kongress** , Munich, DE

Project Progress

After the successful Project Kick-Off, each partner has enthusiastically looked into their tasks within the particular work packages (WP) and started progress towards the objectives. The first deliverables have been submitted and quite some work has been performed during the first months of the AQUARIUS project:

In **WP1** the main system parameters and environmental conditions for the online and inline oil in water analysers were defined in collaboration with the system developers and end user partners. Based on this information a requirement analysis questionnaire was set up and sent to experts in the field of water analysis and potential customers of water analysers. With the results, the requirements document was filled and subdivided regarding different costumer needs and applications. The consolidated requirements deliverable further included information of the regulatory framework and considerations from the end user perspective. Subsequently, draft versions of a detailed specification of all components of the two analyser systems were created. These system specifications were discussed and consolidated at various telephone conferences and face-to-face meetings. Concerning **WP2**, quantum cascade laser structures were designed and grown, and wafer processing has started. Moreover, initial work on the MOEMS module has been done, which includes adaption of the grating to the desired spectral range. In **WP3** the sensor for the broadband spectrometer system was selected according to wavelength, bandwidth and detectivity requirements of the project. The measurement method and the expected signal parameters are now being defined. **WP4** compared hydrocarbon enrichment layers used in literature. Porous silica was identified as the most promising material and a strategy to obtain hydrophobic porous silica was designed and tested. In parallel, the optical interfaces between the spectrometer system and the waveguide sensor have been discussed. Within **WP5** different technical approaches for a potential use in an online extraction module for oil extraction from a water stream have been examined and tested. The components needed have been chosen with input from the requirements definition for oil in water analysis and specifications (WP1). A laboratory testbed was set up for testing single components and the interaction between those. Further work included measurements of different crude and processed oils for the creation of a chemometric database. For dissemination in **WP7**, the project website was set up and an information platform was established within the first three months after the project start. The two deliverables "Internal and external IT communication infrastructure and project website" and "Dissemination and communication kit – Version 1" have been submitted to the European Commission. The project logo, leaflet, announcement letter and several press releases have been created and published. Furthermore, social media channels were established to reach out to a broad audience. With reference to **WP8**, the project has been successfully started and the ongoing work is on good track. Collaboration among partners is well functioning and quite efficient due to effective project management, a well-established IT infrastructure and regular dedicated and focused conference calls. The project quality plan was submitted to the European Commission.

SUBMITTED Public Deliverables

- D7.1 Internal and external IT communication infrastructure and project website (M02)
- D7.2 Dissemination and communication kit - Version 1 (M02)
- D8.1 Project quality plan (M03)

UPCOMING Public Deliverables

- D7.3 Updated plan and initial report on dissemination and communication activities (M06)
- D7.4 Dissemination and communication kit - Version 2 (M06)
- D7.5 Dissemination and communication kit - Version 3 (M12)
- D8.2 Risk Assessment Plan (M12)
- D8.3 1st Interim Progress Report (M12)

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