AEOLUS, leveraging integrated photonics for a miniaturised, cloud connected multi-gas sensor for air quality measurements

Charalampos Zervos
Giannis Poulopoulos, George Syriopoulos, Dimitris Apostolopoulos, Hercules Avramopoulos
Photonics Communication Research Laboratory, National Technical University of Athens, 9 Heroon Polytechniou, Athens, Greece
hzervos@mail.ntua.gr

The quality of the air we breathe is a vital asset affecting human health and well-being, as well as environmental resources such as water, soil and forests. The increasing awareness on air pollution's socioeconomic impacts has significantly promoted initiatives at an international, national and regional level, aiming at legally binding deals for containing greenhouse gases and other harmful trace gases threatening human health. Inherent to any policy for air pollution reduction is a mechanism for monitoring, reporting and evaluation of the measures taken. Currently, air pollution is measured regularly at selected locations, mainly at the largest sources of pollution and in city centres. Accurate air quality monitors are costly and bulky; therefore the number of air pollution stations is limited and assessing the spatial distribution of pollutants, dispersion models are used; however, their accuracy is restricted by virtue of variable traffic distribution as well as micro-meteorological effects of urban geometry such as street canyons. Deploying a dense pollution monitoring network, working in tandem with dispersion models to provide real-time mapping of the spatial and temporal variations of urban air quality with high precision, enabling assessment of exposure at a localized/personal level is needed, especially in view of environmental challenges. The demand for 'smart', networked and truly affordable gas sensors will only grow.
Within this premise, we will present AEOLUS, a Horizon 2020 European Innovation Action project, which aims to being together key technologies to develop an affordable multi gas photonic sensors that is cloud connected, assisted with Big Data analytics deployed in a smart sensing platform. AEOLUS is using MID-IR Absorption Spectroscopy based on Nondispersive infrared (NDIR) techniques with high degree if on-chip integration. AEOLUS goals include the use of low-cost and wafer scale manufacturing and packaging methods to promote the affordability, while leveraging an envisaged proliferation of the sensor in an Internet of Things environment feeding data in artificial intelligence algorithms. More specifically, AEOLUS will capitalise on well-established Silicon (Si) platform, develop low cost and miniaturized, allowing for high integration sensing elements with enhanced performance, investigate the leveraging of CMOS compatible Germanium on Insulator processes and extend detection range up to ~10 μm, use wafer level processes to considerable minimize the sensor's cost and footprint, demonstrate a system on chip integrated photonic sensor for multiple gases, use well established embedding PCB technologies for miniaturisation, develop and validate machine learning models that will provide emerging patterns, accurate chemometric analysis and predictions.
This work has received funding from the European Union's Horizon 2020 innovation programme under grant agreement No. 101017186 (AEOLUS).