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Miniaturized TDLS optical gas sensing device for air quality monitoring

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Abstract

Optical gas sensors and in particular tunable diode laser spectroscopy combine high selectivity of target gases with high accuracy, while exhibiting long-term stability. Compact and integrated devices would introduce these outstanding advantages to a widely available basis. Our recent developments aim towards an integrated hardware, which comprises: (1) the power-supply unit, (2) temperature and current drivers, (3) the sensor head, (4) the signal acquisition and evaluation, as well as (5) a WiFi communication module. By employing application specific integrated circuits a significant form factor and cost reduction has been achieved. Our integrated hardware allows us to employ wavelength modulation spectroscopy, which separates the absorption signal from noise sources of the high frequency digital devices. Gases which exhibit weak absorption lines require long path lengths or high concentrations. As it is desirable to access different species with the same integrated device, a reduction of the absorption path length has to be considered as well. We aim to employ photonic crystal structures (PhCs) in order to decrease the group velocity of light by orders of magnitude in such a way that the interaction time of the probe light with the gas sample increases by the same factor. Suitable PhC structures can be provided by the Photo Assisted Electrochemical Etch technology. The high aspect ratio of the Si rods allows us to treat the structure as 2D PhC, which facilitates coupling and reduces leaky modes. As a first application privacy compliant area monitoring via the measurement of ambient CO_2 is targeted.

Biography

Alexandru Popescu received his Ph.D. from the Technische Universität Darmstadt in February 2010. During his stay at Prof. Dr. Thomas Walther's group he developed a quantum-optical based receiver system for the Brillouin-Lidar; a system for remotely measuring oceanic temperature profiles. During his studies he worked as young research scientist at Daimler-Chrysler and at the Fraunhofer Institute for Computer Graphics Research. He joined Siemens Cooperate Technology in November 2010. His interests comprise a multitude of active and passive spectroscopic techniques and applications, e.g. VCSEL, QCL and photonic crystal based gas sensors. He is author of several peer reviewed scientific papers.