Why ethane? Sensing and analysis of ethane in exhaled air is appropriate for health condition monitoring. While ambient ethane levels are normally below 4 ppb, it was presented that the normal concentration of ethane in exhaled air is only ~ 0.12 particles per billion with higher concentrations indicating possibility of the health problems. Presently, the ethane sensing devices are using mostly mid-wavelength infrared range, wavelength ~ 3 μm. In proposed project I would like to explore the long wavelength infrared range due to the fact that distinct absorption peaks are observed for wavelengths near 12 μm. Significantly the ethane absorption peaks are not interfering with absorption spectra of other common compounds observed in longwave range. In addition, in the longwave range, the two main unfavourable scattering effects of Rayleigh and Mie are meaningfully reduced in comparison to the mid-wavelength, resulting in longwave range being even more favourable.

The literature suggests that the development of type-II superlattices technology will enable realization of infrared detectors with high frequency response and detectivity at operating temperatures sufficiently high to be facilitated by 2-stage thermoelectrical cooling or even for operation at room temperature and competing with well known Mercury Cadmium Telluride. In addition, theoretical analysis shows, that the inherent material parameters of type-II superlattice might be implemented into infrared detector's fabrication by introducing appropriate design changes in the photosensitive elements. That possibility is offered by structures with absorbers connected in series by adequately designed tunneling regions.

The main goal of the proposed project is to design via numerical simulation efforts and subsequently demonstrate molecular beam epitaxy grown InAs/InAsSb type-II superlattice interbond cascade infrared detector characterized with a short response time and sufficiently high detectivity and operating without cryogenic cooling, for implementation within spectroscopic instrumentation for trace sensing of ethane. Furthermore, the proposed project also focuses on the determination of a device structure, *processing*, and GaAs lens formation for interband cascade infrared detectors. I expect to reach detectivity of > 10^9 Jones, response time ~ 1 ns for wavelength ~12 μm and temperature > 230 K.

The proposed project will include research on input performance for ethane sensing to launch the detector's designing procedure and advanced numerical analysis of the carrier transport/response time/detectivity in the interband cascade infrared detector based type-II superlattice InAs/InAsSb. After we will grow type-II superlattice InAs/InAsSb structures on GaAs substrates by the molecular beam epitaxy technique and perform material characterization. Then the fabrication stage will take place (*processing*, GaAs immersion lens formation). After fabrication stage we will characterize detectors: frequency response, detectivity, responsivity and tests for spectroscopy applications - ethane sensing.