MID-INFRARED QUANTUM-CASCADE LASERS AND SOME BIOMEDICAL APPLICATIONS

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Quantum cascade lasers (QCLs) have attracted a great deal of attention from the scientific community since the first publication in 1971 describing their principles [1], and especially since their first practical demonstration in 1994 [2]. The main characteristic that distinguishes QCLs from their sister "laser diodes" is that QCLs are unipolar, i.e. they use only one type of carriers – with the emission of a photon when an electron in the conduction band transitions from one quantum confinement level to another allowing quantum efficiency higher 100%. Thanks to their cascaded structure, QCLs emit in the mid-infrared and terahertz spectral ranges promising huge number of applications in wireless tele- and data-communication, industry, environmental monitoring, agriculture, healthcare, and many other fields of science and technology.

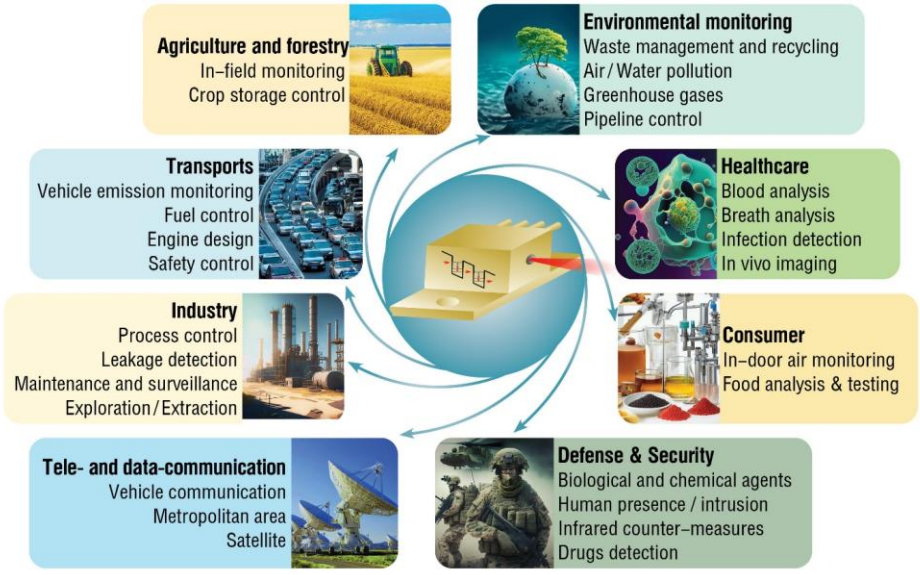

Fig. 1: Schematic representation of various applications of QCLs [3].

The talk will present an overview of the global state of research and development of the mid-IR QCLs, as well as discussion of the original research results at the Ioffe Insitute. Among these, it is worth noting the demonstration of the output power of laser generation of more than 22 W at a wavelength around 4.5 μm and a record-high power exceeding 21 W achieved from QCLs of 8 μm spectral range both at pulsed pumping 100 ns / 11 kHz, the dynamic characteristics of the mid-infrared quantum cascade lasers, as well as the characteristics of quantum cascade detectors for 7-9 μm range fabricated from the QCL structure with measured sensitivity of 20 mA/W, exceeding that of similar detectors with a specially optimized structure. The talk will conclude with come examples of biomedical applications of QCLs.

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[2]. J. Faist et al., Science **264**, 553 (1994)
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