LASER SPECTROSCOPY OF LOW-TEMPERATURE PLASMA WITH ULTRA-HIGH SPECTRAL RESOLUTION AND SENSITIVITY USING FABRY - PÉROT INTERFEROMETER AND OPTICAL PARAMETRIC AMPLIFIER

Plasma is a matter state characterized by the occurrence of a certain number of charged particles (electrons and positive ions), but in the large spatial scale it is electrically neutral. It occurs naturally: in astrophysical objects (stars and interstellar gas nebulas) and on the Earth (in the form of atmospheric discharges). The plasma could be also generated in the laboratory. There exist variable techniques of experimental plasma generation, for example voltage breakdown (electric arc), microwave heating and laser breakdown. Laboratory plasmas obtained via these methods become applicable in more and more various fields of science and industry. They are used, for example, during trials of controlled nuclear fusion obtaining in Tokamak - type reactors, during low - invasive investigations of samples elemental composition, during nanoparticles generation and during precise materials treatment.

In order to fully benefit from advantages of all scientific and technical applications of plasma it is necessary to develop of the effective plasma **diagnostics** method. Such a method should provide reliable information about plasma parameters, such as its chemical composition, temperature, electron concentration, degree of ionization and flow velocity. A significant development of laser techniques in recent years allowed to develop diagnostics techniques consisted in the observation of signals originated from the laser beams scattering on the examined medium. It turns out that the amount of information possible to obtain using scattering methods depends strongly on the spectral resolving power of used measuring equipment. Unfortunately, scattering signals are usually very weak. This feature, connected with required resolving power, causes huge experimental difficulties.

The realization of the proposed research project will consist in the construction of apparatus giving us the possibility to measure weak optical signals with a very high spectral resolving power and with a very high sensitivity. The collected signal will be firstly gained using the **optical parametric amplifier**, that is the device allowing to "transfer" energy from one laser beam to another. Next, the gained signal will be analyzed using the **Fabry - Pérot interferometer**, that is the device projecting the frequency spectrum of incoming light to its spatial distribution being generated on the screen. The experimental setup constructed in such a way will be applied to the diagnostics of various types of plasma generated by laser breakdown in gas.

The realization of the project will contribute to the better understanding of thermodynamic processes taking place in the plasma. Additionally, the measurement equipment constructed during the project realization will become a prototype for similar devices, which could be used in another field of science such as sensitive biological structures imaging, atomic and molecular spectroscopy or atmosphere examination using LIDAR technology, that is working in optical regime equivalent of radar.