

Abstract

The doctoral thesis is comprised of 6 individual chapters, each of which describes a distinct achievement in the development of new devices for the production of laser targets. A brief summary and description of the contents are presented below.

In Chapter 1, I provided an introductory overview of the subject of the thesis, presenting a historical account of the lasers and the interaction of laser pulses with matter. The fundamental concepts associated with laser plasma, including methods of its production, properties, and basic parameters, were elucidated. Additionally, I presented illustrative applications of laser-plasma systems.

Chapter 2 presents the current state of knowledge on laser target systems. Fundamental categories of laser targets, their characteristics, and their applications in laser experiments were presented. The chapter concluded with a summary of the motivation and purpose behind undertaking the subject and carrying out the work on the development of new devices for producing laser targets based on the solution of the gas target concept.

In Chapter 3, I presented a new design of developed systems for producing targets containing gas clusters and aerosols. The first device is based on a double stream gas-puff target, the second device is novel solution for producing an aerosol target using an ultrasonic nebulisation method and a single gas-puff target directly in vacuum conditions.

In Chapter 4, the results of the experimental work on the characterisation of the manufactured laser targets are presented. The transmission and target density maps were determined as well as the dispersion characteristics of gas cluster and aerosol structures in vacuum and the results of imaging gigant gas clusters using optical microscopy.

Chapter 5 presents the results of demonstration experiments using the developed devices.

Chapter 6 provides a summary of the developed laser targets, including their design, observed advantages, and disadvantages. This chapter also presents conclusions from the first experiments and proposals for the development of the subject and further research.