Preface

According to its nature, gas discharge is the passage of electric current through a gas that is located under the action of external fields. The principal property of gas discharge, its self-maintenance, was formulated in the beginning of the twentieth century [1–5] and consists in the ionization balance inside gas discharge. This is provided by formation of an ionized gas called a gas discharge plasma, and the ionization equilibrium is supported in this plasma. Because of this character of the passage of electric current through a gas, the processes in the gas discharge plasma are of importance. Basic processes in gas discharge were studied long ago and contemporary information about them differs weakly from what we have 10 years ago. For example, the values of Townsend coefficients and ion mobilities [6–8] published more than 70 years ago differ weakly from contemporary values. In addition, the peculiarities of various schemes and regimes of gas discharge are studied and contained in various works on gas discharge (in particular, [9–23]), as well as the processes in a gas discharge plasma and its kinetics [24–40]. We add to this that the gas discharge plasma includes most part of plasma applications.

Thus, gas discharge plasma is the widespread type of plasma whose properties are determined by the processes in this plasma. Therefore, one can connect parameters of a certain gas discharge plasma with the parameters of processes in this plasma. However, in spite of understanding this connection in principle, it is impossible to give a universal algorithm to express properties of a gas discharge plasma through the rates of corresponding processes because of a variety of types of gas discharges, as well as a variety of their regimes, geometric constructions, and configurations of external fields that support this gas discharge. Therefore, considering this problem in a given book, we restrict by simple configurations and types of external fields as well as by helium and argon as a working discharge gas. Hence, this book has a methodology goal for fulfilling numerical calculations of various parameters of a gas discharge plasma of helium and argon. This restriction allows us to use the real rates and rate constants for the processes in the gas discharge plasma and to obtain certain simple algorithms for determining the plasma parameters and regimes of its evolution. This book is based on the Russian author's book [41] where the above concept is formulated and methodical

approaches are developed. This book consists of two parts, so that the first part is a textbook on processes and properties of a gas discharge plasma, and the second part includes problems related to some aspects of a helium and argon gas discharge plasma.

The book is aimed at two groups of readers. The first group is students who first study the problem of the gas discharge plasma. They can understand general principles of a gas discharge plasma as well as the methods to analyze some aspects of this area up to numerical determination of plasma parameters. The second group of readers are users who can obtain methods and codes for computer solutions of some problems related to certain applications.

Moscow Boris M. Smirnov

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Smirnov, B.M.

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