

Samoilovich · Gibalov · Kozlov

Physical Chemistry of the Barrier Discharge

2. Auflage

CONTENTS

INTRODUCTION	7
---------------------	----------

INTRODUCTION TO THE SECOND EDITION	8
---	----------

CHAPTER 1. Electric characteristics of the barrier discharge.

1.1 Barrier discharge volt-ampere characteristics.	9
1.2 Barrier discharge burning voltage.	13
1.3 Electric theory of ozonizers.	14
1.3.1 Ozonizers voltage is lower than the discharge ignition voltage.	15
1.3.2 Ozonizers voltage is higher than the discharge ignition voltage.	17
1.3.3 Ozonizer's active power.	18
1.3.4 Power coefficient.	20

CHAPTER 2. Structure and microscopic characteristics of the barrier discharge.

2.1 Definition of microdischarge and set of microdischarges.	23
2.2. Microdischarge channel geometry.	27
2.3 Value of the charge transferred in discharge region.	32
2.4. Dynamics of the processes in microdischarge channel..	38
2.5 Microdischarge channel's power characteristics	41
2.5.1 Energy of electrons in microdischarge channel	41
2.5.2 Radiation in microdischarge channel.	45
2.5.3 Heavy particles temperature in microdischarge channel	48
2.5.4 Energy dissipation and temperature in microdischarge channel	54
2.6 Microdischarges and electrical theory of ozonisers	58

CHAPTER 3. Numerical modelling of the barrier discharge

3.1 Mathematical model of the microdischarge.	68
3.1.1 General approach to the problem.	68
3.1.2 Basic equations, boundary and initial conditions.	69
3.2 Methods to solve problems of numerical modelling	71
3.2.1 Three stages of the processes development in microdischarge.	72

3.2.2	The first stage of numerical modelling.	72
3.2.3	The second and the third stages of the numerical modelling.	73
3.3	Results of the microdischarge numerical modelling.	74
3.3.1	Spatial and temporal distributions of the discharge parameters between conductive electrodes.	74
3.3.2	The role of photoionization, cathode emission and gas electronegativity.	78
3.3.3	Spatial and temporal distributions of microdischarge parameters between dielectric electrodes.	80

CHAPTER 4. Ozone synthesis from oxygen

4.1.	Specific energy factor and ozone electrosynthesis kinetics.	87
4.2.	Influence of power supply frequency on ozone synthesis.	91
4.3.	Influence of gas pressure and discharge gap dimension on ozone electrosynthesis.	92
4.4.	Influence of humidity on the ozone synthesis.	95
4.5.	Distribution of ozone concentration over the discharge gap.	97
4.6.	Energy consumption for ozone synthesis.	101
4.7.	Distribution of gas temperature in the discharge gap.	103
4.8.	Basic reactions which determine ozone synthesis	108
4.9.	Kinetics of chemical reactions in the discharge gap.	113
4.10.	Ozone saturation concentration	117
4.11.	Discrete model of ozone synthesis in the barrier discharge	120
4.12.	Temperature dependence of the ozone synthesis kinetics.	127

CHAPTER 5. Synthesis of ozone and nitrogen oxides from the air

5.1. Influence of physico-chemical conditions on ozone electrosynthesis from the air	131
5.1.1. Specific energy and frequency of the applied voltage	131
5.1.2. Influence of temperature, gas contents and humidity	133
5.2. Nitrogen oxides electrosynthesis	135
5.2.1. NO	136
5.2.2. NO ₂	140
5.2.3. NO ₃	143
5.2.4. N ₂ O	143
5.2.5. N ₂ O ₅	146
5.2.6. Kinetics of chemical reactions in the barrier discharge in the air.	151

CHAPTER 6. Ozone synthesis into special kind of discharge

6.1. Ozone synthesis in the barrier discharge with dielectric of high specific capacity.	157
6.1.1. Volt-ampere characteristics and glow voltage	158
6.1.2. Influence of the supply circuit parameters on the electric characteristics of the barrier discharge.	159
6.1.3. Ozone and nitrogen oxides synthesis, energy consumption.	161
6.1.4. Problems of the active power definition in the barrier discharge with dielectric of high specific capacity.	163
6.2. Ozone synthesis in the discharge with pulse supply.	164
6.2.1. Ozone synthesis in the barrier discharge with pulse supply.	164
6.2.2. Ozone synthesis in the discharge with conducting electrodes	168

APPENDIX A

Basic microdischarge parameters in the barrier discharge 172

APPENDIX B

Basic parameters of barrier microdischarges 173

APPENDIX C

New results in barrier discharge investigations 185

APPENDIX D

Diagnostic methods at dielectric barrier discharges 201

LITERATURE

249