

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Structure of semiconductor device . . . . .	2
1.2	Mathematical models . . . . .	5
1.3	Review of previous results . . . . .	9
1.4	Notation . . . . .	11
<b>2</b>	<b>Mathematical problem and main results</b>	<b>13</b>
2.1	Intial boundary value problem for hydrodynamic model . . . . .	13
2.2	Formal computation of relaxation limits . . . . .	15
2.3	Asymptotic behavior of hydrodynamic model . . . . .	17
2.4	Relaxation time limits . . . . .	19
2.5	Outline of proofs . . . . .	21
<b>3</b>	<b>Stationary solutions</b>	<b>23</b>
3.1	Unique existence of stationary solutions . . . . .	23
3.2	Relaxation limits of stationary solutions . . . . .	33
<b>4</b>	<b>Energy-transport model</b>	<b>37</b>
4.1	Uniform estimate of local solution . . . . .	40
4.2	Semi-global existence of solution . . . . .	43
4.3	Global existence of solution . . . . .	50
4.4	Energy relaxation limit . . . . .	59
4.5	Additional regularity . . . . .	60
<b>5</b>	<b>Hydrodynamic model</b>	<b>67</b>
5.1	Uniform estimate of local solution . . . . .	67
5.2	Semi-global existence of solution . . . . .	74
5.3	Global existence of solution . . . . .	82
5.4	Momentum and energy relaxation limits . . . . .	93

<b>6 Appendix</b>	<b>95</b>
6.1 Time local solvability of energy-transport model . . . . .	95
6.2 Time local solvability of hydrodynamic model . . . . .	102