7.
Semiconductors:
Experiment

(references refer to the list of publications given in chapter 12)

A. DC Driven pin-Diodes and p-n-p-n Layer Devices

A. 7.1 General remarks

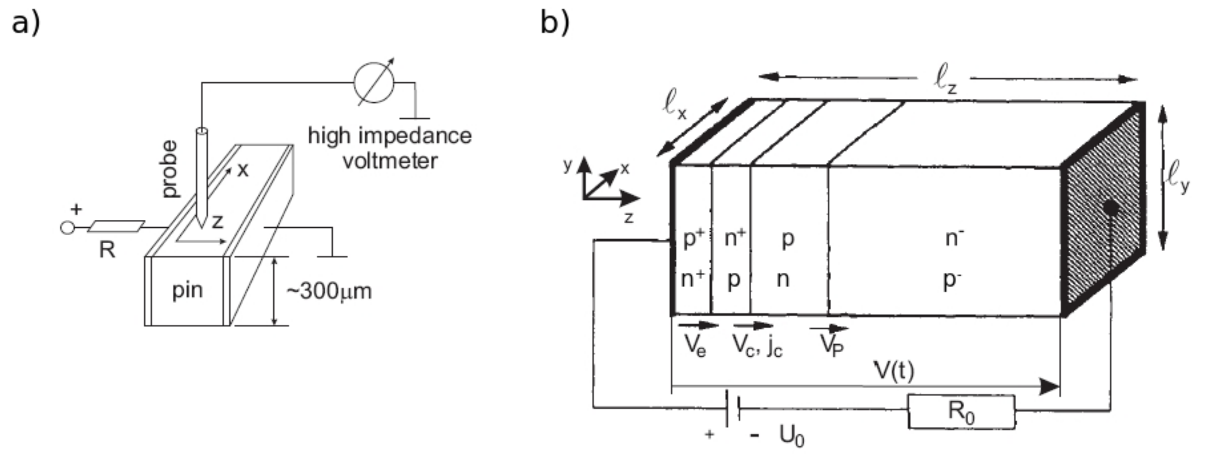

Fig. 7.1

Experimentally investigated dc driven semiconductor layer systems in the form of pin-diodes (a) and a p-n-p-n semiconductor layer devices (b) are represented in fig. 7.1. Qualitatively also these systems can be modelled by the device fig. 2.1 with the characteristics fig. 2.2 discussed in the chapter A Model for Pattern Formation. Another approach is based on the knowledge of the (current density)-(voltage) characteristics of the individual layers including spatial coupling via diffusion. This subject will be referred to in chapter Semiconductors: Theory.

Patterns of interest appear in some plane parallel to the metallic contacts e.g. in the current density, the resulting luminescence radiation density and the potential distribution. The systems are considered as quasi 1-dimensional if the extension e.g. in x-direction is large and that in y-direction is small with respect to the characteristic space scale of the observed patterns. If the extension is large in both directions the system is referred to as quasi 2-dimensional. In fig. 7.1a we also indicate of how the potential is recorded. For the interpretation of observed solitary filaments as localized structures (LSs) in the form of dissipative solitons (DSs) we remember the notes made in relation to fig. 4.1 of chapter DC Gas-Discharge Systems: Experiment.

A.7.2 Graphical representation of selected results

The following is a series of figures reflecting main results that have been obtained experimentally in relation to the investigation of planar pin-diodes and p-n-p-n semiconductor devices.

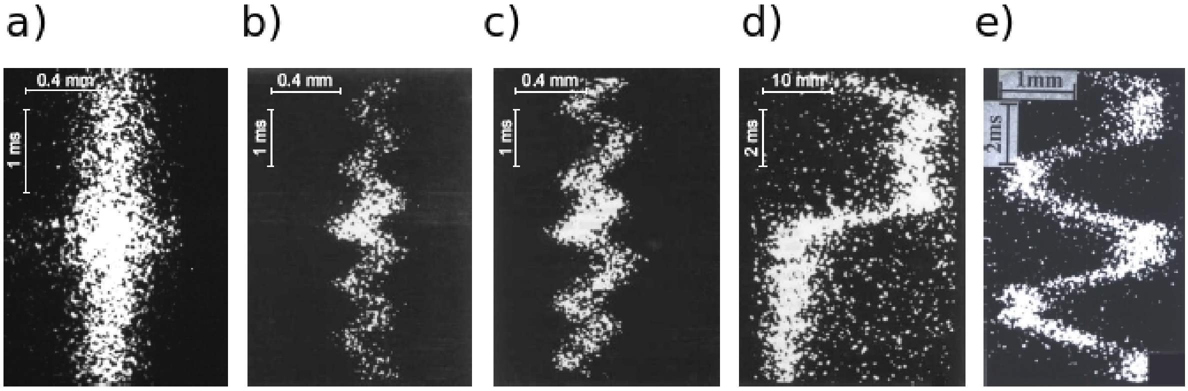

Fig. 7.2a-e

Experimental patterns in the form of filaments observed in the quasi 1-dimensional system fig. 7.1b with a p^+-n^+-p-n^- layer structure by using a streak camera. In the space-time plot the abscissa denotes the space coordinate and the ordinate the time. While the global current increases from (a) to (e) a stationary solitary filament undergoes a bifurcation cascade in the following form: (stationary filament) → (pendulating filament) → (pendulating filament with period doubling) → (travelling of the filament from one boundary to the other interrupted by pendulating motion) → (periodic travelling of the filament from one boundary to the other interrupted by unresolved pendulating motion) [e.g. Pu020, Pu022] - compare to: experiment figs. 3.13, 4.7, 4.18, 5.9; theory figs. 8.1, 9.8, 9.13, 9.14 - see also [Pu018; Pu033; Pu043]

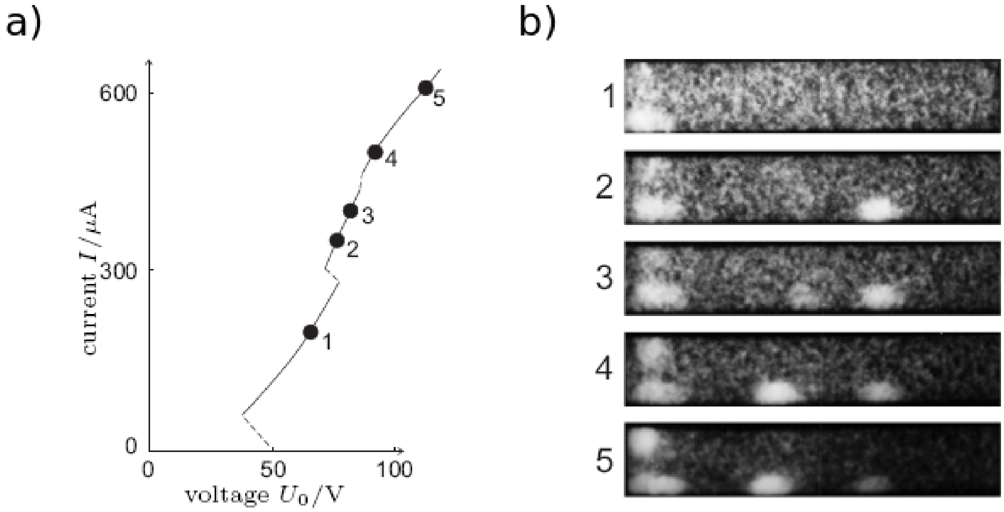

Fig. 7.3a,b

Experimentally observed stationary filaments observed the quasi 1-dimensional system fig. 7.1b with an n^+-p-n-p^- layer structure: Global (current)-(voltage) characteristic (a) and corresponding luminescence radiation density distribution (b). The numbers in (b) correspond to the positions being indicated in (a). [Pu022] - compare to: experiment figs. 3.12, 4.5, 4.6, 4.16, 5.7, 5.18, 7.10; theory figs. 3.12, 9.6, 9.10 - see also [Pu018; Pu022]

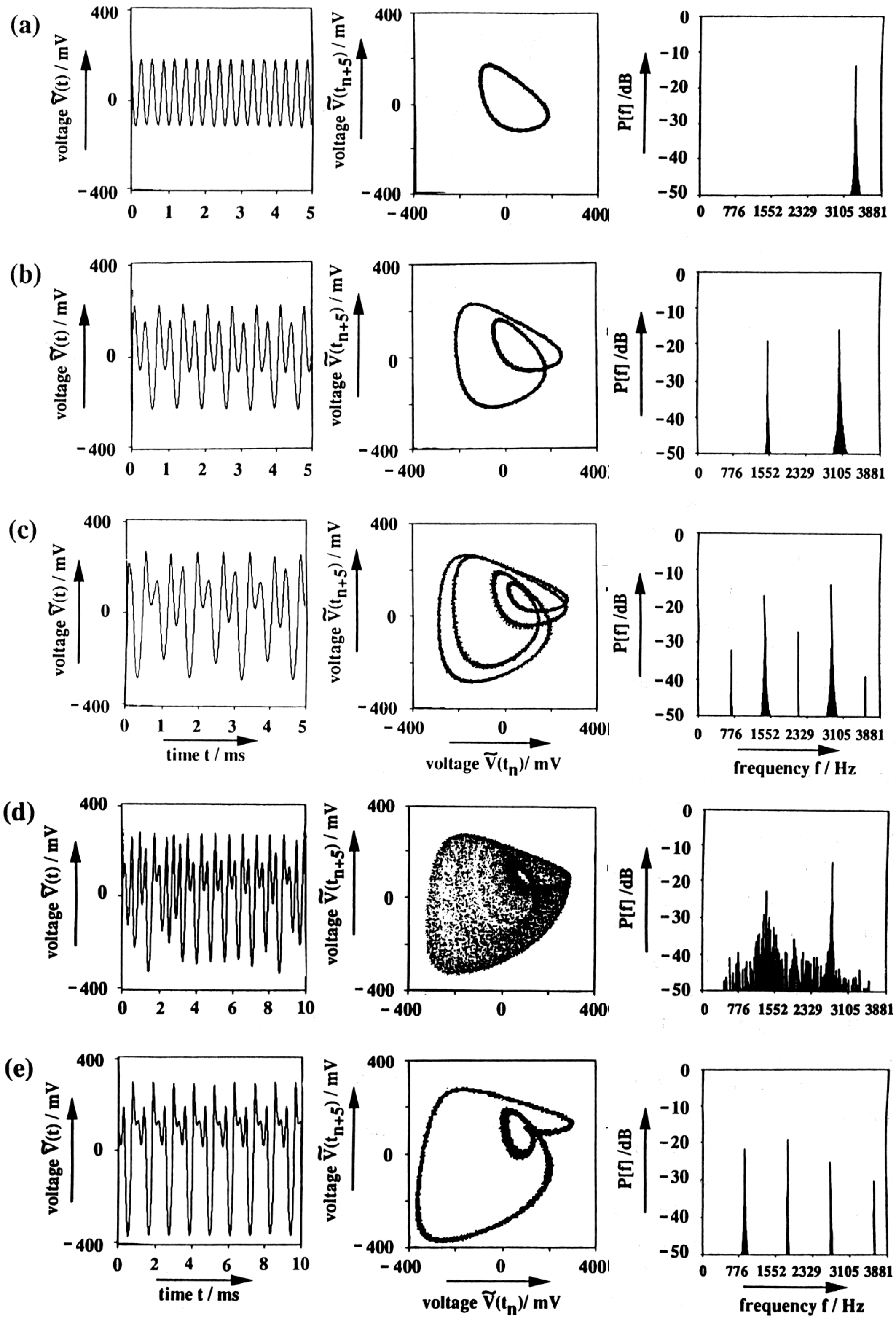
(a)
(b)
(c)
(d)
(e)
voltage Ṽ(t) / mV
voltage Ṽ(t_{n+5}) / mV
P[f] /dB
time t / ms
voltage Ṽ(t_n)/ mV
frequency f / Hz
0 776 1552 2329 3105 3881

Fig. 7.4a-e

Fig. 7.4a-e

Experimentally observed dynamical behaviour related to a pendulating single filament observed in the quasi 1-dimensional system fig. 7.1b with an p^{+}-n^{+}-p-n^{-} layer structure. The driving voltage is increased from (a) to (e). 1. column: Voltage drop $\tilde{V}(t)$ at the device as a function of time; 2. column: $\tilde{V}(t_{n+5})$ versus $\tilde{V}(t_n)$; 3. column: Power spectrum $\tilde{V}(t)$. The experimental results clearly indicate period doubling ending up in a chaotic motion with the filament retaining its solitary structure. [Pu030]

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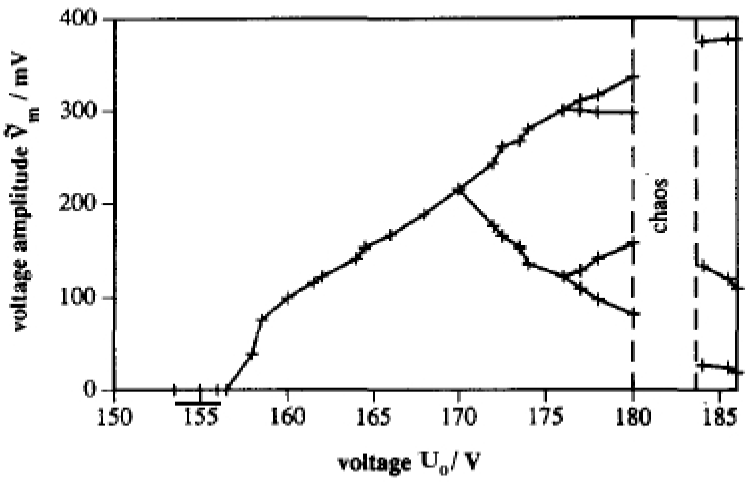

Fig. 7.5

Experimentally observed period doubling cascade related to the measurements of fig. 7.4. Here the maximum of the voltage $\tilde{V}(t)$ is plotted as a function of the driving voltage.

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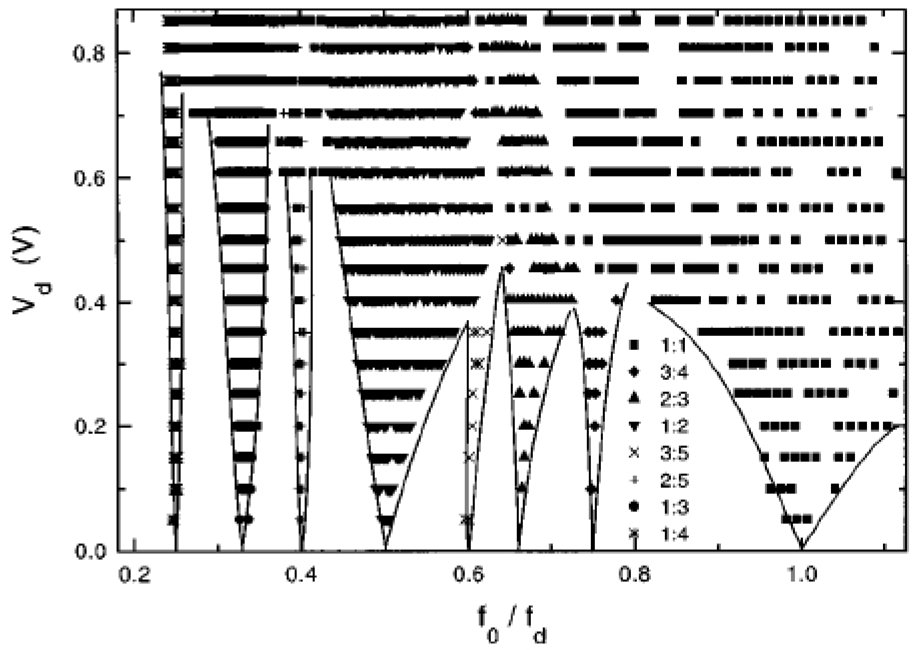

Fig. 7.6

Experimentally observed Arnold tongues (due to frequency locking) based on a pendulating single filament in the ac driven quasi 1-dimensional system fig. 7.1b with a p^+-n^+-p-n^- layer structure. The amplitude and frequency of the sinusoidal driver are V_d and f_d while f_0 denotes the fundamental frequency of the filament. [Pu050]

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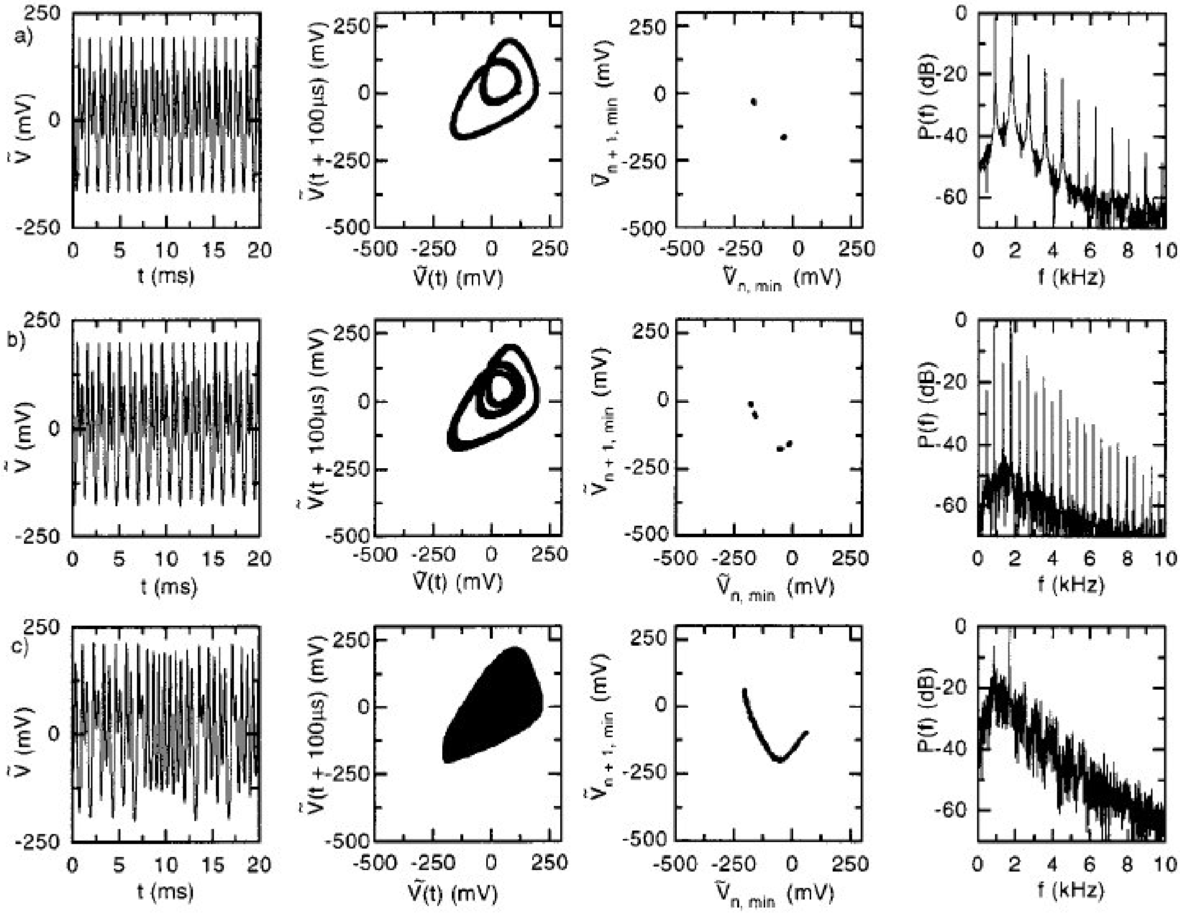


Fig. 7.7

Experimentally observed frequency doubling in the situation fig. 7.6 with the frequency of the driver being decreased from (a) to (c). 1. column: Voltage drop $\tilde{V}(t)$ at the device as a function of time; 2. row: corresponding plot $\tilde{V}(t+\mu s)$ versus $\tilde{V}(t)$; 3. column: return map generated by plotting a given minimum $\tilde{V}(t)$ in dependence of the value of the preceding one; 4. column: power spectrum of $\tilde{V}(t)$. [Pu050]

A. 7.3 Listing of main results

With respect to the abbreviations used in the following listing of observed phenomena we refer to the Introduction.

Pu003: **Radehaus, Kardell, Baumann, Jäger, Purwins (1987)**

isolated stationary fs

exp: 1d-SCD (pin diodes) , $R_0 \neq 0$ – stat fs

observation of stationary solitary filaments and related DSs in pin diodes - presence of a global coupling - claim, that these and many other planar semiconductor devices can be considered as r-d systems with respect to lateral patter formation - claim that the high ohmic resistively layer with monotonic (current density)-(voltage) characteristic supports spatially inhomogeneous patterns if it is in contact with an effective layer with S-shaped (current density)-(voltage) characteristic - stressing the importance of the activator inhibitor principle with local activation and lateral inhibition - see also: Semiconductors: Theory, Reaction-Diffusion Equations

Pu006: **Baumann, Symanczyk, Radehaus, Purwins, Jäger (1987)**

isolated stationary fs

exp : 1d-SCD (pin diodes) , $R_0 \neq 0$ – stat fs

continuation of [Pu003] - observation of stationary solitary filaments and related DSs in pin diodes - presence of a global coupling - filament diameter in good agreement with numerical results obtained from the 2-component reaction-diffusion equation - see also: Semiconductors: Theory, Reaction-Diffusion Equations

Pu018: **Niedernostheide, Dohmen, Willebrand, Schulze, Purwins (1992)**

isolated stationary and travelling fs

exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat, trav fs

exp: 1d-SCD, $R_0 \neq 0$, II (n^+-p-n-p^- diode) - stat fs

theo: 2-k + gc, R^1 – num: stat DS, trav DSs

isolated pendulating fs

exp: 1d-SCD I, $R_0 \neq 0$ - pend fs

theo: 2-k, $\mu \neq 0$ + gc, R^1 – num: pend DSs

bifurcation: complex dynamical scenario based on fs

exp: 1d-SCD I, $R_0 \neq 0$ - essentially: (stat hom) ↔ (pend) ↔ (trav)

exp: 1d-SCD, $R_0 \neq 0$, II - num: snaking

theo: 2-k + gc, R^1 - num: snaking

experimental detection of stationary, pendulating and travelling solitary filaments and related DSs in p-n-p-n semiconductor layer devices as well as complex dynamical bifurcation scenario - snaking in p-n-p-n semiconductor devices - qualitative description of stationary, travelling

solitary filaments and related DSs as well as snakingin terms of the 2-component reaction-diffusion system - **see also:** DC Gas-Discharge Systems: Experiment, Reaction-Diffusion Equations

Pu020: Niedernostheide, Kerner , Purwins (1992)

isolated stationary and travelling fs

exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat fs, trav fs

theo: 1d-SCD, $R_0 \neq 0$, I - stat , trav DSs, semiconductor specific modelling (semi-quant)

isolated pendulating fs

exp: 1d-SCD, $R_0 \neq 0$, I - pend

theo: 1d-SCD, $R_0 \neq 0$, I - pend DSs, semiconductor specific modelling (semi-quant)

interaction of fs: reflection

exp: 1d-SCD, $R_0 \neq 0$, I - refl at boundary

theo: 1d-SCD, $R_0 \neq 0$, I - refl at boundary, semiconductor specific modelling (semi-quant)

bifurcation: complex dynamical bifscenario of fs

exp: 1d-SCD, $R_0 \neq 0$, I - complex dynamical bif scenario: essentially (hom stat state) ↔ (stat f) ↔ (pend f) ↔ (trav f)

theo: 1d-SCD, $R_0 \neq 0$, I - complex dynamical bif scenario: essentally (hom stat state) ↔ (stat f) ↔ (pend f) ↔ (trav f) semiconductor specific modelling (semi-quant)

experimental detection of a complex dynamic bifurcation scenario in p-n-p-n semiconductor devices starting with a stationary homogeneous state and ending with a travelling solitary filaments and related DS - development of a corresponding semiconductor specific model - **see also:** Semiconductors: Theory

Pu022: Niedernostheide, Arps, Dohmen, Willebrand, Purwins (1992)

isolated stationary and travelling fs

exp : 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat, trav fs

theo: 2-k + gc, R^1 - stat, trav DSs

exp : 1d-SCD, $R_0 \neq 0$ II (n^+-p-n-p^- diode) - stat fs

theo: 2-k + gc, R^1 - stat DSs

isolated pendulating fs

exp: 1d-SCD, $R_0 \neq 0$, I - pend fs (investigated by a streak camera and potential measurements)

theo: 2-k + gc, R^1 - stat, pend DSs

interaction of fs: reflection

exp : 1d-SCD, $R_0 \neq 0$, I - ref at boundary

bifurcation: complex dynamical bifscenario based on fs, snaking

exp : 1d-SCD, $R_0 \neq 0$, I - complex bif scenario: essentially (hom stat state) ↔ (stat f) ↔ (pend f) ↔ (trav f)

theo: 2-k + gc, R^1 - bif scenario: (stat DS) ↔ (pend DS) ↔ (trav DS),

exp : 1d-SCD, $R_0 \neq 0$ II - snaking

theo: 2-k + gc, R^1 - snaking

reasonable qualitative description of the observed static and dynamic solitary filament and related DS behaviour in p-n-p-n semiconductor devices in term of the 2-component reaction diffusion model - **change from dynamical behaviour in device I to stationary behaviour in device II**

due to change of the relevant time constants - see also: AC Gas-Discharge Systems: Experiment, Reaction-Diffusion Equations

Pu030: **Niedernostheide, Kreimer, Schulze, Purwins (1993)**

isolated stationary fs

exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat fs

isolated pendulating fs

exp: 1d-SCD, $R_0 \neq 0$, I - pend fs

bifurcation: frequency doubling cascade based on fs

exp: 1d-SCD, $R_0 \neq 0$, I - frequency doubling cascade based on the transition from a single stat DS to a single pend f; ending up in a chaotic pend motion of a single f

experimental detection of a cascade of frequency doubling in p-n-p-n semiconductor devices based on pendulum like dynamics of a single solitary filaments and related DSs

Pu033: **Niedernostheide, Ardes, Or-Guil, Purwins (1994)**

isolated stationary and travelling fs

exp : 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat , trav fs,

theo: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- diode) - semiconductor specific modelling: stat DS , trav fs (semi-quant)

isolated pendulating fs

exp : 1d-SCD, $R_0 \neq 0$, I - pend fs

theo: 1d-SCD, $R_0 \neq 0$, I - semiconductor specific modelling: pend fs (semi-quant), breath fs,

interaction of fs: reflection

exp : 1d-SCD, $R_0 \neq 0$, I - refl at boundary

theo: 1d-SCD, $R_0 \neq 0$, I - refl at boundary, semiconductor specific modelling (semi-quant)

bifurcation of fs: complex scenario

exp : 1d-SCD, $R_0 \neq 0$, I - complex bif scenario, essentially of the form: (hom stat state) ↔ (stat f) ↔ (pend f) ↔ (trav f)

theo: 1d-SCD, $R_0 \neq 0$, I - semiconductor specific modelling: complex bif scenario, essentially of the form (hom stat state) ↔ (stat DS) ↔ (pend DS) ↔ (trav DS), (semi-quant); frequency doubling based on the dynamics of a breathing DS

continuation of [Pu018, Pu020, Pu022, Pu030] - numerical solutions of the semiconductor specific model developed in [Pu020] for p-n-p-n semiconductor devices: semi-quantitative agreement with the complex bif scenario, essentially of the form (hom stat state) ↔ (stat f) ↔ (pend f) ↔ (trav f) reported e.g. in [Pu022] - numerical solutions of the same model: frequency doubling based on the a breathing solitary filaments and related DS exhibiting frequency doubling in p-n-p-n semiconductor devices; the scenario formally is very similar to experimental results on frequency doubling that are reported in [Pu030] based on a pendulating solitary filaments and related DS - see also: Semiconductors: Theory

Pu035: **Niedernostheide, Kreimer, Kukuk, Schulze, Purwins (1994)**

isolated stationary and travelling fs

exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat, trav fs

(investigated by a streak camera and a potential probe)
continuation of [Pu018, Pu020, Pu022, Pu030, Pu033] - experimental proof that the diffusion lengths and the time constants deduced from the measured luminescence radiation density and the potential govern the dynamics of solitary filament and related DS with respect to stationary and travelling DSs

Pu036: **Niedernostheide, Purwins (1994)**
summary - material contained also in [Pu018, Pu020, Pu022, Pu030, Pu033, Pu35]

Pu038: **Niedernostheide, Goßen, Purwins (1994)**
material contained also in [Pu020, Pu022, Pu030, Pu033, Pu35]

Pu042: **Wierschen, Niedernostheide, Gorbatyuk, Purwins (1995)**
isolated stationary and travelling fs
exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - trav fs investigated by the electron induced current method
exp: 1d-SCD, $R_0 \neq 0$ II (n^+-p-n-p^- diode) - stat fs investigation by electron induced current method
bifurcation: snaking
exp: 1d-SCD, $R_0 \neq 0$ II (n^+-p-n-p^- diode) - snaking
application of the electron induced current method to the record of solitary filaments and related DSs.

Pu050: **Niedernostheide, Brillert, Kukuk, Purwins, Schulze (1996)**
isolated pendulating fs
exp : 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - pend fs
bifurcation of fs: frequency locking and Arnold tongues
exp: 1d-SCD, $R_0 \neq 0$, I , dc driven, superimposend by a periodic ac signal - based on a single pend f: frequency locking with Arnold tongues, quasi-periodicity, chaos
based on the pendulum like motion of a single solitary filaments and related DSs: experimental observation of frequency locking with Arnold tongues, quasi-periodicity and chaos

Pu052: **Kukuk, Reil, Niedernostheide, Purwins (1996)**
isolated stationary fs
exp: 1d-SCD, $R_0 \neq 0$, I (p^+-n^+-p-n^- layer system) - stat fs and their optoelectronic manipulation
experimental proof that LSs in semiconductor materials can be manipulated optoelectronically

Pu064: **Schöll, Niedernostheide, Parisi, Prettle, Purwins (1998)**
summary - material also contained in [Pu018, 020, Pu022, Pu025, Pu030, Pu033, Pu035, Pu036, Pu50]

Pu127: **Purwins, Amiranashvili (2007)**

summary - simple patterns: e.g. isolated solitary filaments and related DSs, stripes, hexagons and rotating spirals - patterns of higher with solitary filaments and related DSs as elementary building blocks: e.g. "molecules" and "many body systems" in the form of crystal-, liquid-, gas-like arrangements, chains and nets - universal experimental behaviour for a certain class of systems containing: planar ac and dc gas-discharge systems, electrical networks, semiconductor layer systems, chemical solutions and biological systems - theoretical definition of the corresponding universality class: writing down a 3-component reaction-diffusion system serving as a kind of normal form for the qualitative description of the experimentally observed self-organized patterns - illustration of the formation of solitary filaments and related DSs in planar electrical transport systems on the basis of the 2-component reaction diffusion equation - see also: Electrical Networks: Experiment and Theory, DC Gas-Discharge Systems: Experiment, AC Gas-Discharge Systems: Experiment, Gas-Discharge: Theory, Semiconductors: Theory, Reaction-Diffusion Equations

B. Ac Driven ZnS:Mn Films

B. 7.1 General remarks

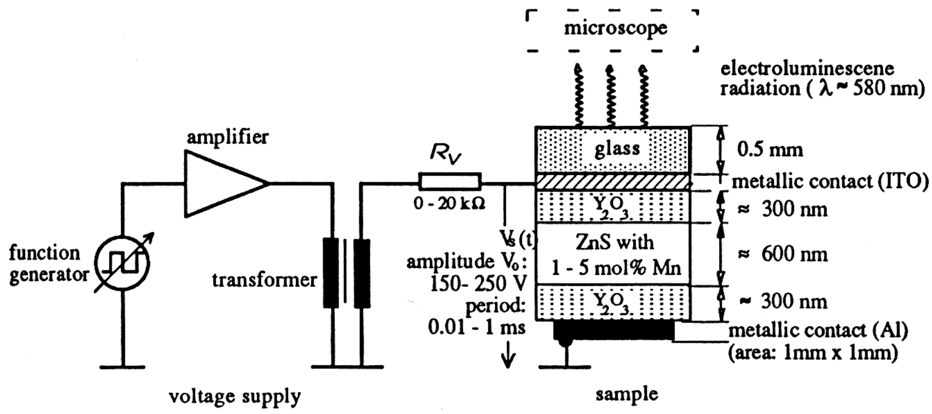


Fig. 7.8

Schematic representation of the cross section of the quasi 2-dimensional ac driven ZnS:Mn semiconductor layer device. From the momentary cathode being one of the metallic contact, electrons are emitted into the conduction band of the ZnS:Mn layer by tunnelling through the Y_2O_3 layer. The electrons are accelerated and via band-band impact ionization additional electrons are generated at the Mn centres. Finally the electrons are collected at the momentary anode thereby generating space charges. Self-organized patterns are observed in the ZnS:Mn layer through the transparent ITO electrode: regions of high electron current vertical to the ZnS:Mn layer are visible by Mn ions of this region emitting radiation in the visible when returning to the ground state. [e.g. Pu044] - Though exhibiting the largest variety of self-organized patterns among all semiconductor systems, the experimental investigation of ZnS:Mn based devices is made extremely difficult due to degradation phenomena.

Also in the present case we refer to stationary patterns provided the local amplitude and phase is constant in time. The question whether or not the observed localized structures (LSs) are dissipative solitons (DSs) in the sense of the Introduction has not been settled finally.

B.7.2 Graphical representation of selected results

The following is a series of figures reflecting main results that have been obtained experimentally in relation to the investigation of ac driven ZnS:Mn devices.

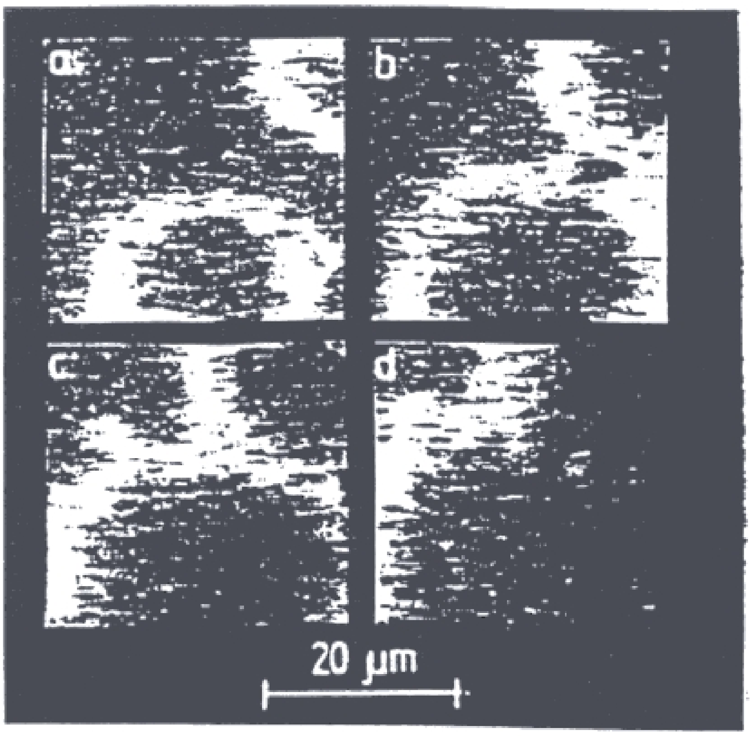
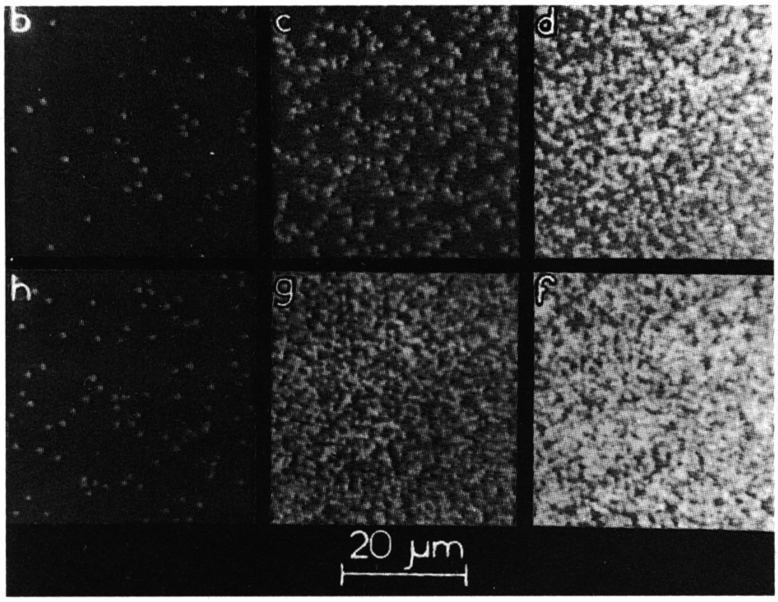


Fig. 7.9

Experimentally observed radiation density patterns in the system fig. 7.8: two independent travelling waves (a) come into touch with each other (b), suffer from strong interaction (c) and finally a single propagating wave is left (d). [e.g. Pu038, Pu044]

A)



B)

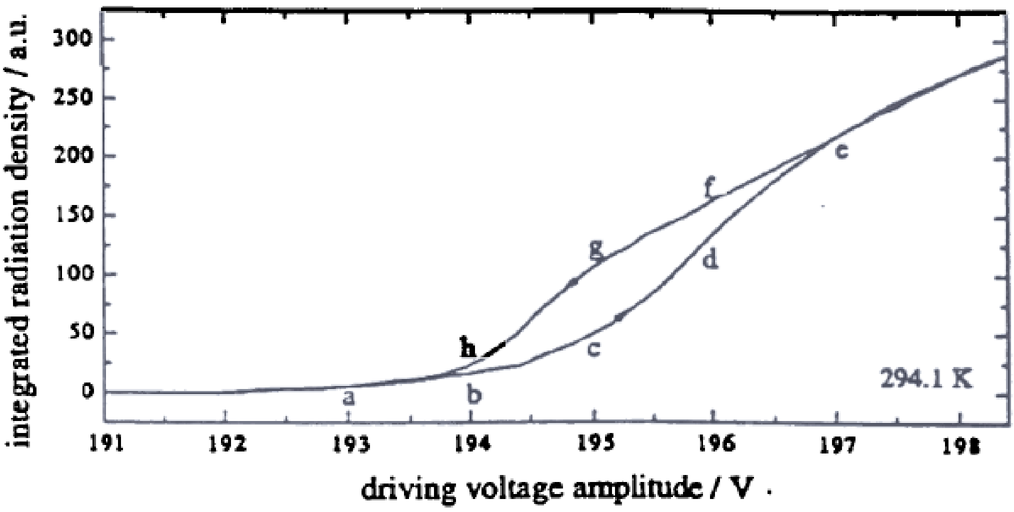


Fig. 7.10

Experimentally observed radiation patterns in the system fig. 7.8: stationary filaments in a quasi 1-dimensional gas-discharge system. When increasing the ampliude of the driving ac voltage a cascades of bifurcations to increasing number of filaments is observed (A). The corresponding plot of the emitted integral luminescence radiation in dependence of the driving voltage is depicted in (B) and exhibits strong hysteresis. [Pu044] - compare to: experiment figs. 3.12, 4.5, 4.6, 4.16, 5.7, 5.18, 7.3; theory figs. 3.12, 9.6, 9.10

B. 7.3 Listing of main results

With respect to the abbreviations used in the following listing of observed phenomena we refer to the Introduction.

Pu038: **Niedernostheide, Gossen, Purwins (1994)**

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat fs

splitting of fs

exp: 2d-SCD ZnS:Mn - splitting

interaction of fs: formation of molecules

exp: 2d-SCD ZnS:Mn - large "molecules" in the form of clusters made of fs

generation, annihilation of fs: due to interaction or spontaneously

exp: 2d-SCD ZnS:Mn - gen of stat, trav fs: spontaneously from the background, from the tails of a trav waves or strings, from entire decay of strings waves

exp: 2d-SCD ZnS:Mn - ring shaped waves; collision of ring waves leads to a non-circular open distortion wave, rings disappear when interacting with the boundary, front propagation

miscellaneous non f patterns

exp: 2d-SCD ZnS:Mn - rotation of large patches

overview on various self-organized patterns

Pu044: **Goßen, Niedernostheide, Purwins (1995)**

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat, trav fs, propagation by hopping; bright and dark stat fs; step-wise motion of fs

splitting of fs

exp: 2d-SCD ZnS:Mn - splitting in the course of hopping

interaction of fs: formation of molecules

exp: 2d-SCD ZnS:Mn - large "molecules" in the form of clusters made of fs

generation, annihilation of fs: due to interaction or spontaneously

exp: 2d-SCD ZnS:Mn - gen of stat, trav fs: spontaneously from the background, from the tails of a trav s or strings, from entire decay of strings, from decaying waves, from inhomogeneities, annni of stat, trav fs: spontaneously, one f disappears in the course of the collision of two; burst of fs into strings

fronts

exp: 2d-SCD ZnS:Mn - trav fronts

waves

exp: 2d-SCD ZnS:Mn - ring shaped waves; collision of ring waves leads to non-circular open distorted waves, rings disappear at the boundary, front propagation (Pu044)

many f systems

exp: 2d-SCD ZnS:Mn - irregular patches made of many fs rotating as a whole and undergoing period doubling after some time; stationary statistically distributed fs

miscellaneous non f patterns

exp: 2d-SCD ZnS:Mn - rotation of large patches; large complexes with global oscillations; networks made of fluctuating strings (width of strings) = (related f diameter); coexistence of moving fs and strings; strings merge when touching

bifurcation: snaking

exp: 2d-SCD ZnS:Mn - snaking

overview on various self-organized patterns - see also: Semiconductors: Theory

Pu046: Or-Guil, Ammelt, Niedernostheide, Purwins (1995)

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat fs

fronts

exp: 2d-SCD ZnS:Mn - trav fronts of expanding domains

waves

exp: 2d-SCD ZnS:Mn - net of connected waves

many f systems

exp: 2d-SCD ZnS:Mn - irregular patches made of many fs rotating as a whole and undergoing period doubling after some ; stationary statistically distributed fs; clusterns of filaments

bifurcation: snaking

exp: 2d-SCD ZnS:Mn - snaking

summary of some results on quasi 2-dimensional ZnS:Mn systems and discussion of the relation to 2-component reaction-diffusion systems - see also: Reaction-Diffusion Equations

Pu059: Kukuk, Zuccaro, Niedernostheide, Purwins (1997)

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat, trav fs

many f systems

exp: 2d-SCD ZnS:Mn - irregular arrangement of many stat fs

miscellaneous non f patterns

exp: 2d-SCD ZnS:Mn - moving strings, coexistence of the latter with fs

discussion of the influence of temperature on the observed patterns

Pu064: Schöll, Niedernostheide, Parisi, Prettle, Purwins (1998)

summary - this material is also contained in [Pu018, Pu020, Pu022, Pu025, Pu030, Pu033, Pu035, Pu036, Pu50].

Pu070: Vlaseno, Denisova, Veligura, Zuccaro, Niedernostheide, Purwins (1999)

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat, trav fs

fronts

exp: 2d-SCD ZnS:Mn - fronts; expanding circular domains

waves: rotating spirals in R^2

exp: 2d-SCD ZnS:Mn - rotating spirals

other waves

exp: 2d-SCD ZnS:Mn ring shaped waves; collision of ring waves leads to non-circular open distorted waves; rings disappear at the boundary; front propagation

miscellaneous non f patterns

exp: 2d-SCD ZnS:Mn - networks made of fluctuating strings

investigation of point defects by photodepolarization spectroscopy, determination of the charge transfer characteristic and discussion of the relation to spatial pattern formation

Pu072: Zuccaro, Niedernostheide, Kukuk, Strych, Purwins (1999)

bifurcation

exp: 2d-SCD ZnS:Mn - 2-dimensional bif diagram with frequency and driver amplitude as parameters and the following phases: homogeneous low current, clusters of many filaments, fronts, strings, essentially interacting circular waves breaking up in the course of time

first generation of an experimental bifurcation diagram in an ac driven ZnS:Mn layer system

Pu076: Vlasenco, Denisova, Veligura, Zuccaro, Niedernostheide, Purwins (2000)

material essentially also contained in [Pu070]

Pu077: Vlaseno, Denisova, Kononets, Veligura, Gumenyuk, Zuccaro, Niedernostheide, Purwins (2000)

isolated stationary and travelling fs

exp: 2d-SCD ZnS:Mn - stat fs, dependence on sample thickness

waves

exp: 2d-SCD ZnS:Mn - collision of ring waves leads to a non-circular open distorted waves; rings disappear at the boundary; front propagation

many f systems

exp: 2d-SCD ZnS:Mn - stat statistically distributed f

this material is partly contained also in [Pu072, Pu070] - systematic investigation of the influence of the thickness of the insulator layer on pattern formation

Pu088: Raker, Kuhn, Kuligk, Fitzer, Redmer, Zuccaro, Niedernostheide, Purwins (2002)

first principle calculation of impact ionization, modelling carrier transport by a drift-diffusion model and comparison of the theoretical results with the experimentally determined dissipative current - see also:
Semiconductors: Theory

Pu091: Vlasenko, Purwins, Popov, Gumenyuk, Klimenko, Kononets, Niedernostheide, Veligura, Zuccaro, (2002)

analysis of the dependence of pattern formation on temperature with the result that temperature increase supports pattern formation

Pu093: **Vlasenko, Purwins, Kononets, Niedernostheide, Veligura, Zuccaro, Gumenyuk (2002)**
extended representaqtion of [Pu091]

Pu094: **Vlasenko, Purwins, Kononets, Niedernostheide, Veligura, Zuccaro, Gumenyuk (2002)**
this material is largely also contained in [Pu070, Pu076]

Pu096: **Zuccaro, Raker, Niedernostheide, Kuhn, Purwins (2003)**
point defects are investigated by photo-depolarization-spectroscopy - specific experimental features of the latter correlate with experimentally observed self-organized patterns - carrier transport is modelled by a drift-diffusion model and the results are compared to the theoretical and experimental dissipative currents

Pu108: **Vlasenko, Purwins, Denisova, Kononets, Niedernostheide, Veligura, Zuccaro (2004)**
summary of the material also contained in [Pu070,Pu076,Pu077,Pu091, Pu093]

Pu127: **Purwins, Amiranashvili (2007)**
summary - simple patterns: e.g. isolated solitary filaments and related LSs/DSs, stripes, hexagons and rotating spirals - patterns of higher complexity with solitary filaments and related LSs/DSs as elementary building blocks: e.g.”molecules” and “many body systems” in the form of crystal-, liquid-, gas-like arrangements, chains and nets - universal experimental behaviour for a certain class of systems containing: planar ac and dc gas-discharge systems, electrical networks, semiconductor layer systems, chemical solutions and biological systems - theoretical definition of the corresponding universality class: writing down a 3-component reaction-diffusion system serving as a kind of normal form for the qualitative description of the experimentally observed self-organized patterns - illustration of the formation of solitary filaments and related LSs/DSs in planar electrical transport systems on the basis of the 2-component reaction diffusion equation - see also: Electrical Networks: Experiment and Theory, DC Gas-Discharge Systems: Experiment, AC Gas-Discharge Systems: Experiment, Gas-Discharge: Theory, Semiconductors: Theory, Reaction-Diffusion Equations