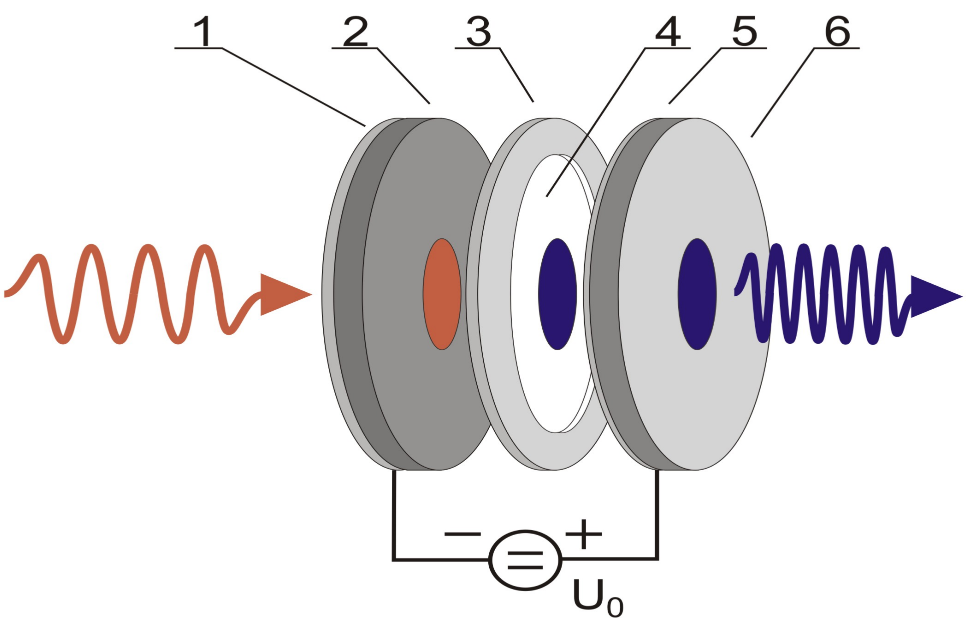
10.
Applications

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

A. Ultra Fast Infrared to Visible Image Converter

A. 10.1 General remarks



1. electrical contact, transparent with respect to IR-radiation
2. semiconductor wafer with internal photo effect in the IR
3. isolating spacer

4. gas-discharge space
4. electrical contact, transparent with respect to the visible
5. glass substrate

Fig. 10.1

Fig. 10.1

Based on the device Fig. 4.10 of the chapter DC Gas-Discharge Systems: Experiment an interesting device has been developed allowing for a fast conversion of infrared (IR) images into the visible. - The locally increased intensity of an infrared image coming in from the left, locally decreases the resistively of the high ohmic semiconductor layer via the internal photo effect. In turn this generates a local discharge of which the locally emitted light intensity is in the visible. The latter is proportional to the local incoming infrared intensity. This results in an image conversion from the infrared to the visible provided the energy gap of the semiconductor is appropriate to allow for the internal photo effect in the IR. Together with existing framing cameras operating in the visible it was possible to realize the present time fastest device for capturing images in the IR. - The crucial point is, that the time constant for the conversion is smaller than 10^{-6} s. (for references see the following section A. 10.2)

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A. 10.2 Listing of main results

Pu029: **Astrov, Portsel, Teperick, Willebrand, Purwins (1994)**
development of an ultra-fast converter for infrared image conversion to the visible, the device is based on the 2d-dc-GDS - the device allowed for the construction of the fastest IR-camera in the world - speed investigations

Pu037: **Willebrand, Astrov, Portsel, Terperick, Gauselmann, Purwins (1994)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029]: observation of ionization waves

Pu040: **Willebrand, Astrov, Portsel, Terperick, Gauselmann, Purwins (1994)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu37]: influence of operation parameters

Pu047: **Willebrand, Astrov, Portsel, Terperick, Gauselmann, Purwins (1995)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040]: demonstration of operation as part of an image acquisition system

Pu055: **Portsel, Astrov, Reimann, Purwins (1997)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047]: experiments and modelling with respect to time resolution

Pu065: **Portsel, Astrov, Reimann, Ammelt, Purwins (1999)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055]: demonstration that the response time of the device is in the submicrosecond range at liquid N_2 temperature

Pu082: **Kim, Maurer, Astrov, Bode, Purwins (2001)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065]: minimization of switching time using optimal control methods from mathematics

Pu085: **Marchenko, Matern, Purwins, Astrov, Portsel (2002)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082]: investigation of noise

Pu086: **Matern, Marchenko, Astrov, Portsel, Purwins (2002)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085]: application of the converter for the determination of the spatio-temporal behaviour of the cross section of a 1.318 µm Nd:YAG, a 2.79 µm Er:YSGG and a 2.94 µm Er:YAG laser; monitoring of a Nd:YAG Laser welding process

Pu087: **Matern, Marchenko, Purwins (2002)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085, Pu086]: essentially a repetition of material from [Pu086]

Pu103: **Marchenko, Matern, Purwins, Astrov, Portsel (2003)**
development of an ultra-fast converter for infrared image conversion to the visible - the device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085, Pu086, Pu087]: increase of sensitivity due to the application of a fiber optic taper

Pu106: **Träger, Strinic, Schröder, Denz, Belic, Petrovic, Matern, Purwins, (2003)**
development of an ultra-fast converter for infrared image conversion to the visible. The device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085, Pu086, Pu087, Pu103]: investigation of the organization and control of optical spots in a photorefractive crystal by means of the IR image converter and a camera operating in the visible

Pu120: **Portsel, Marchenko, Purwins (2005)**
development of an ultra-fast converter for infrared image conversion to the visible. The device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085, Pu086, Pu087, Pu103, Pu106]: use of microcapillary plates as a built-in intensifier

Pu121: **Portsel, Marchenko, Matern, Purwins (2005)**
development of an ultra-fast converter for infrared image conversion to the visible. The device is based on the 2d-dc-GDS – continuation of [Pu029, Pu037, Pu040, Pu047, Pu055, Pu065, Pu082, Pu085, Pu086, Pu087, Pu103, Pu106, Pu120]: determination of the line spread function and the modulation transfer function in order to describe spatial resolution - result: the spatial resolution is mainly determined by the gas layer

B. Optoelectronic Devices

On the basis of the devices Fig. 4.10 of chapter DC Gas-Discharge Systems: Experiment and Fig. 5.3 of chapter AC Gas-Discharge Systems: Experiment one may think of various additional application. In the following we will mention only some of them.

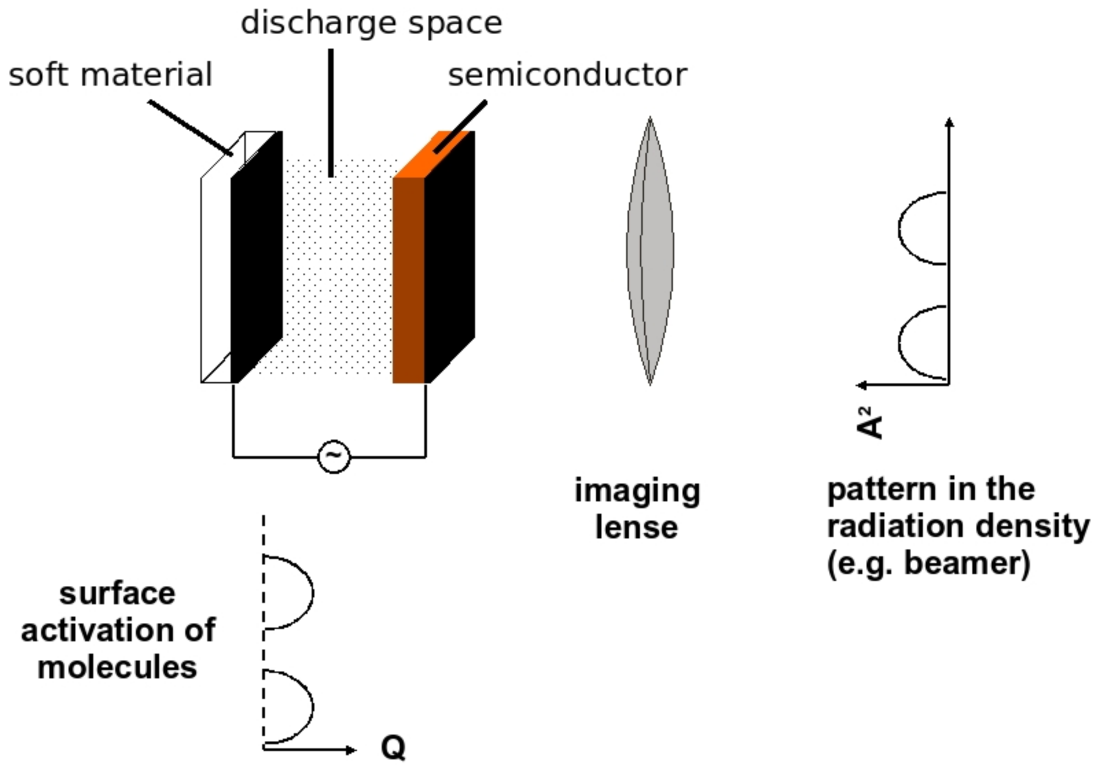

Fig. 10.2

Optoelectronic control of soft material preparation. In the 2-dimensional ac system of the kind fig. 5.3 of the chapter Gas-Discharge Systems: Experiment one of the dielectric layers is replaced by a photosensitive semiconductor waver. A predefined image on the right generates a corresponding resistivity profile in the semiconductor waver via the internal photo effect. In turn this leads to a corresponding discharge pattern in the discharge space and to a corresponding surface charge pattern on opposite dielectricum. Since the resulting surface charge distribution may allow for surface charge dependent reactivity of deposited soft material we deal with an interesting potential method for material preparation.

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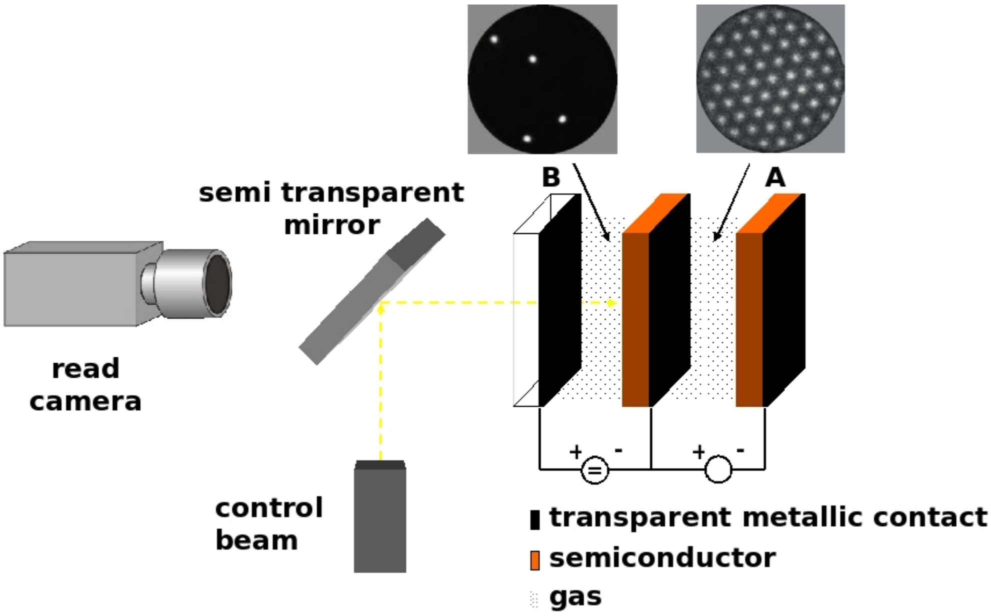

Fig. 10.3

Optoelectronically controlled self-organized memory. Two devices of the kind Fig. 4.10 of chapter DC Gas-Discharge Systems: Experiment are put into series. The right hand device is operated in the way that a regular stationary hexagonal pattern is organized in the discharge space A. The individual light spots from A, again via the internal photo effect, in the semiconductor waver of the left hand device define sites in the discharge plane of B on which filaments can be set and erased by a control beam. Readout is made by an appropriate camera.

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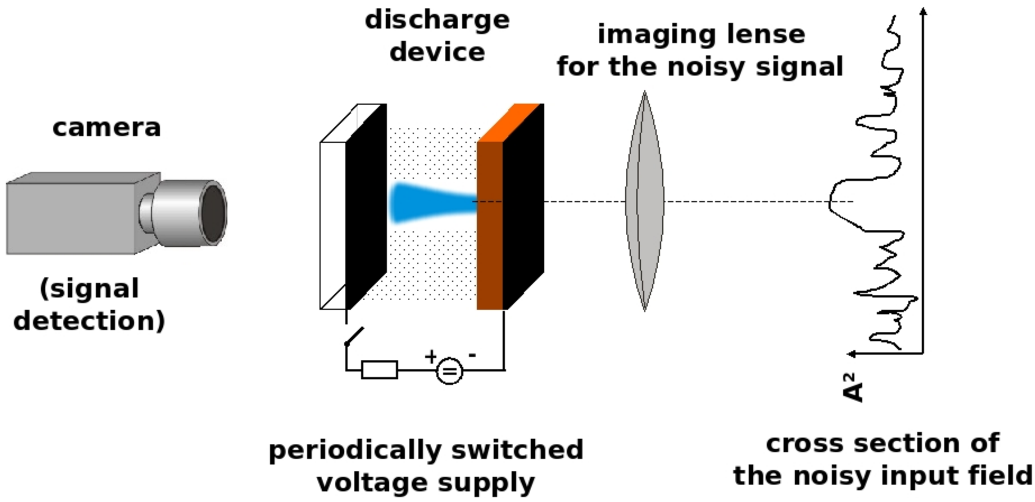

Fig. 10.4

Maximum or threshold detector with local amplification and lateral suppression. The device operates similar to that of fig. 4.10 of chapter DC Gas-Discharge Systems: Experiment and fig. 10.1. At its maximum, a noisy radiation input field generates a filament in the discharge space. Once a filament is present the ignition of a second one is suppressed effectively due to the presence of the series resistor R_o.

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C. Voronoi-Diagrams

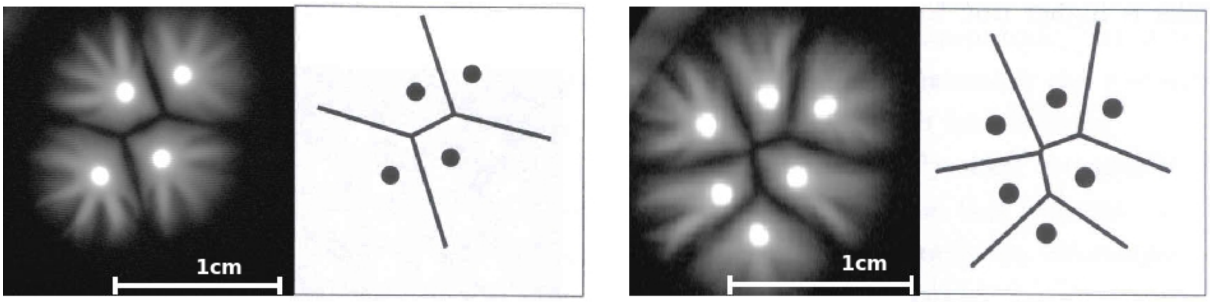

Fig. 10.5

Voronoi diagrams can be generated in a self-organized manner by self-organized filaments as centres in quasi 2-dimensional ac systems of the kind fig. 5.3 of the chapter Gas-Discharge Systems: Experiment. [Pu090]- The centres may also be introduced via material inhomogeneities or via optoelectronic control [Pu090].

D. Kohonen-Networks

see chapter Miscellaneous