Ultrafast multiple-TM-doped short-period superlattice photoconductors for efficient THz antennas in key enabling technologies - A German university is looking for research cooperation or licensees

Summary

Profile type	Company's country	POD reference
Technology offer	**Germany**	**TODE20230217012**

Profile status	Type of partnership	Targeted countries
PUBLISHED	**Research and development cooperation agreement** **Commercial agreement with technical assistance** **Investment agreement**	• **World**

Contact Person	Term of validity	Last update
Johannes BÖHMER	**10 Mar 2023** **9 Mar 2025**	**7 Mar 2024**

General Information

Short summary

A German university has developed ultrafast photoconductors consisting of layers of differently doped adjacent photosensitive semiconductors. These can be used for terahertz (THz) antennas used for transmitting and receiving THz electromagnetic waves in emerging THz systems: e.g. security systems for detecting hazardous material or quality management systems for detecting material defects. The technology has been tested at lab scale (TRL 4) and is offered for research cooperation or licensing.

Full description

The proposed technology invented by a German University jointly with a German non-university research institute concerns ultrafast photoconductors which consist of layers of differently doped adjacent photosensitive semiconductors. These different dopants allow for independent optimization regarding the electron-hole recombination time and the resistance (dark current).

These photoconductors can be used for terahertz (THz) antennas which are important for transmitting and receiving THz electromagnetic waves in emerging THz systems, e.g. security systems for detecting hazardous material or quality management systems for detecting material defects. Due to small sizes, THz antennas usually suffer from a high loss in performance. Since THz waves do not alter the chemical structure – thus making them safe for use on living beings in contrast to UV and x-ray radiation – THz systems are considered a key enabling technology (KET).

A photoconductor as proposed consists of pairs of differently doped very thin (<10nm) layers of semiconductors. Both layers are doped with arbitrary transition-metals (TM) (like Fe, Rh, Ru, or others). Essential is that layer 1 and layer 2 have at least an order of magnitude different doping concentration. The goal is to reach a homogeneous dopant distribution in one layer, and a profound TM-cluster (or other defects) formation in the other layer. Thus the functionality of electrical compensation and the functionality of fast carrier recombination can be split over two layers with different doping levels meaning both functionalities can be optimized simultaneously. These pairs of layers can be optionally mended with spacer layers to prevent interdiffusion of the dopands and this structure is repeated until the total thickness of all layers is between 0,5µm and 2µm.

The technology has been tested at lab scale (TRL 4) and is offered for research cooperation or licensing. Hence, the university is looking for partners from the micro- and nanotechnology sector and from relevant research institutes for a cooperation under a research cooperation agreement or under a commercial agreement with technical assistance (licensing).

Advantages and innovations

The application of differently doped adjacent photosensitive semiconductors allows for independent optimization regarding the electron-hole recombination time and the resistance (dark current).

Within photoconductors of previous design (state of the art), photosensitive semiconductors can only be optimized towards either electron-hole recombination time or electric resistance, but not both. Since the optimum of the one is never the optimum of the other, previous state of the art photoconductors are decidedly less efficient than the proposed ultrafast Multiple-Transition-Metal-doped Short-Period Superlattice Photoconductor.

Technical specification or expertise sought

Stage of development

Lab tested

Sustainable Development goals

• Goal 9: Industry, Innovation and Infrastructure

IPR Status

IPR granted

IPR Notes

DE 10 2020 213 957 B3 - granted 09/2021
PCT/DE2021/200163 - filed 10/2021
The technology has been co-created by the German university and a German research institute

Partner Sought

Expected role of the partner

The university is looking for partners from the micro- and nanotechnology sector and from relevant research institutes for a commercial agreement with technical assistance (licensing) or a research cooperation agreement.

Partners sought under a commercial agreement with technical assistance are industry, SMEs or research institutes (incl. universities). Through licensing, the partner will be authorized to use the licensed technology for the development and production of new products, e.g. innovative terahertz (THz) antennas.

In case of a research and development cooperation agreement the partner sought could also be industry, an SME or an academic partner in order to jointly continue the development of the technology.

The patented technology presented herein is also available for purchase under investment agreement.

Type of partnership

Research and development cooperation agreement

Commercial agreement with technical assistance

Investment agreement

Type and size of the partner

- **Big company**
- **University**
- **R&D Institution**
- **SME <=10**
- **SME 50 - 249**
- **SME 11-49**

Dissemination

Technology keywords

- **001001015 - Semiconductors**
- **01002001 - Micro and Nanotechnology related to Electronics and Microelectronics**
- **10002008 - Measurement and Detection of Pollution**
- **10001004 - Hazardous Materials**
- **09001006 - Optical material testing**

Market keywords

- **02006004 - Data processing, analysis and input services**
- **03001002 - Customised semiconductors**
- **01004002 - Data communication components**
- **08002003 - Process control equipment and systems**
- **03004002 - Components testing equipment**

Targeted countries

- **World**

Sector groups involved

- **Electronics**

Media

Images

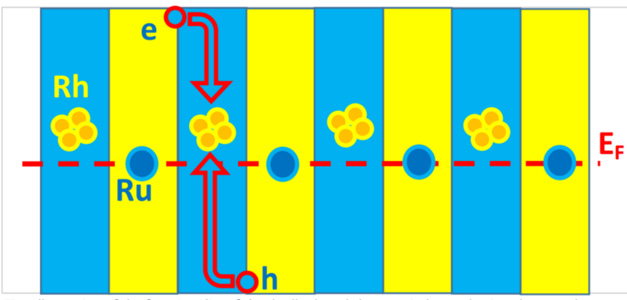

Fig.: Illustration of the functionality of the dually-doped short-period-superlattice photoconductor. Ru-doped layers pin the Fermi level E_F in the middle of the semiconductor band-gap, resulting in a high electrical resistance of the material. Rh clusters in the alternating layers provide the ultra-fast electron-hole recombination centers, resulting into ultra-short recombination times.

Illustration of the functionality of the dually-doped short-period-superlattice photoconductor.