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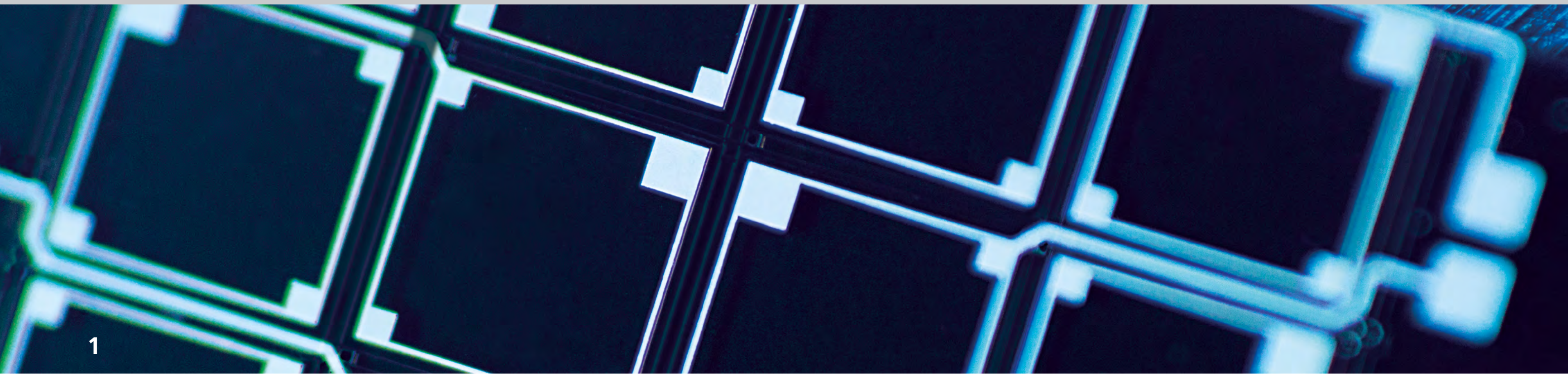

1 *Picture of an integrated 4x4-SiC-UV-Sensorarray*

ION IMPLANTED SIC UV-PHOTODIODES

TUNEABLE FOR UV-A/B SUNLIGHT AND VISIBLE BLIND UV-C DETECTION

General description

- A p+n-junction formed by ion implantation in epitaxially grown n-layer on highly n-doped 4H-SiC-substrate
- Strong photon absorption in the desired UV range
- No absorption of visible light, e.g. from artificial sources

Advantages

- Visible-blind design (excellent rejection of artificial light sources)
- Higher sensitivity without cooling compared to silicon
- Less intrinsic noise compared to silicon sensor devices
- EQE up to 60% (next generation EQE > 75% expected)
- Compatible with ams "multi-sensor platform chip" from EU-FP7 MSP project (no. 115495) and MPW service

Features

- Wide bandgap of 4H-SiC (3.26 eV) offers possibility of visible blind UV-detection without additional optical filters
- Selectivity to sunlight can be adjusted by the sensor design
- Low intrinsic carrier concentration - very low dark current
- Ion implantation technology offers possibility of very shallow emitters
- Reduced process effort and higher homogeneity compared to fabrication using epitaxy
- Integrated two-dimensional sensor arrays feasible

Benefits

- Higher turnover from new applications and increased sensitivity
- Cost reduction from room temperature operation (no sensor cooling required)

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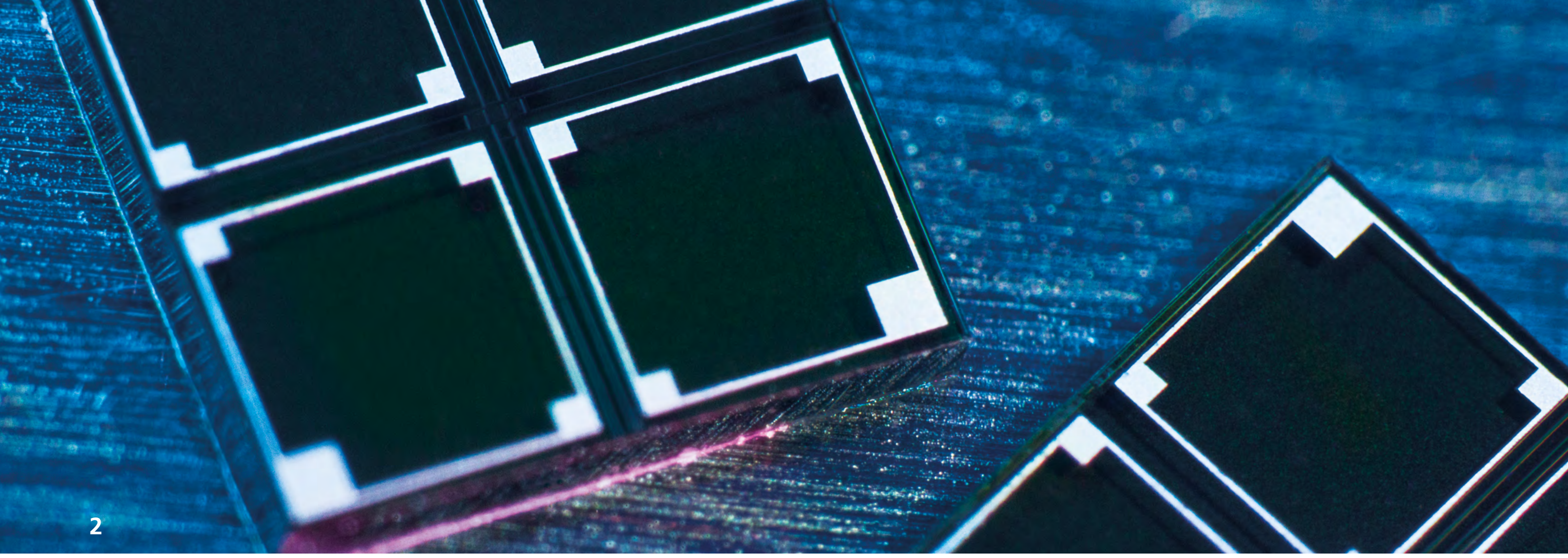


2 *Integrated 2x2 SiC-UV-sensor arrays*

Spectral responsivity

- Tunable maximum, e.g. at 260 nm: 110 mA/W
- Near-constant responsivity from 270-300 nm achievable
- Typical peak external quantum efficiency of 55%

Reverse IV-characteristics (typ.)

- Dark current < 1 nA/cm²
- Typ. SNR > 57 dB
- Cap. typ. 20 nF/cm² at 0 V

Temperature characteristics

- Operation up to 200 °C (limited by packaging, usability of SiC chip at higher temperatures)
- Even higher photocurrent at higher temp. (up to 200 °C), especially for longer wavelengths
- No measurable increase of dark current (Fig. 2)

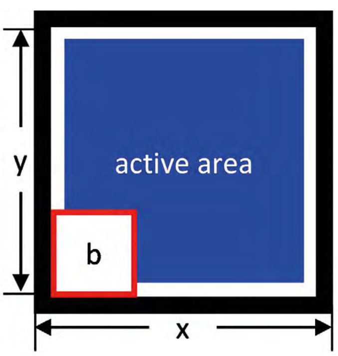
Application examples

- UV water purification (typ. 254 nm) - Fig. 1
- Flame and heat detection (several peaks) - Fig. 3
- Sunlight UV (280 – 380 nm) monitoring - Fig. 4 & 5

Device dimensions

- Die size x (typ.): 1.5 mm*
- Emitter-size y: 1.3 mm*
- Optical area (typ.): 1.6 mm²*
- Bond pad area b (typ.): 0.25 x 0.25 mm*

  *others on request



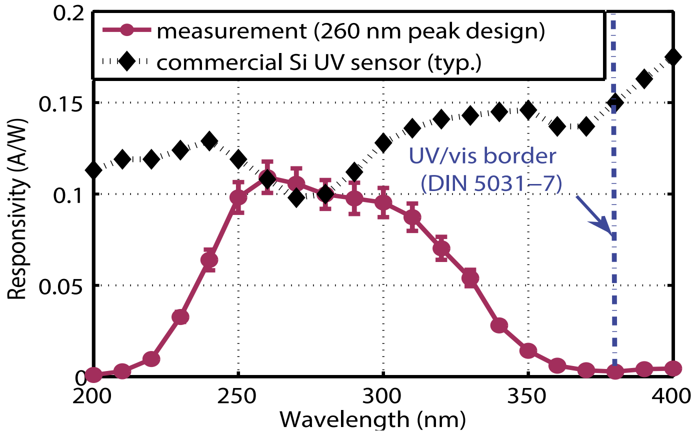


Fig. 1: Measured responsivity of a 260 nm peak device in comparison to a commercially available UV sensitive Si-photodiode

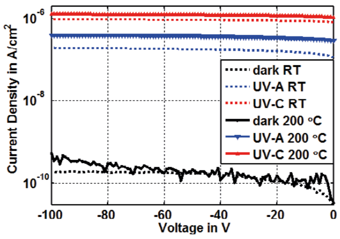


Fig. 2: Typical reverse IV-curve with UV-A (broadband) and UV-C lamp (254 nm peak) turned on and off @RT and 200 °C

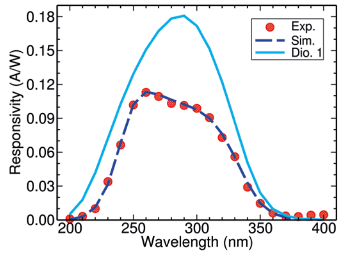


Fig.3: TCAD simulation of new 290 nm peak design with EQE > 75% (green), sim. model for old design (see Fig. 1) shown for verifcation

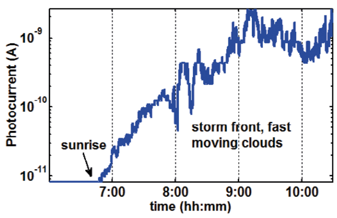


Fig. 4: Photocurrent vs. time during storm ‚Niklas' in Germany in 2015

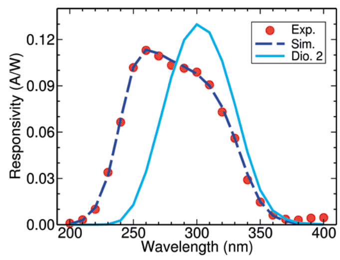


Fig. 5: TCAD simulation of new solar UV design (green)