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FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY

1

1 *Snubber device for power electronic converters*

DEVICES

From sensors to power

Power device simulation

Verification of novel designs - „more than moore"

- Process simulation of device structures
  - Definition of process flow from scratch or from existing design
  - Incorporation of custom mask layouts
  - Verification of manufacturability
- Simulation of extracted device structures
  - Evaluation of electrical performance
  - Calculation of quasistatical behavior
  - Dynamic small-signal analysis
- Comparison of different design variations
  - Optimization of device design and process flow
  - Shorter development cycles due to smaller feedback loops

Device development

Customized solutions for semiconductor devices

- Novel and exclusive fabrication capabilities
  - Processing of lightly doped substrates
  - Beyond-CMOS processing
  - Alternative substrate materials, e.g. SOI, SiC, GE

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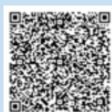
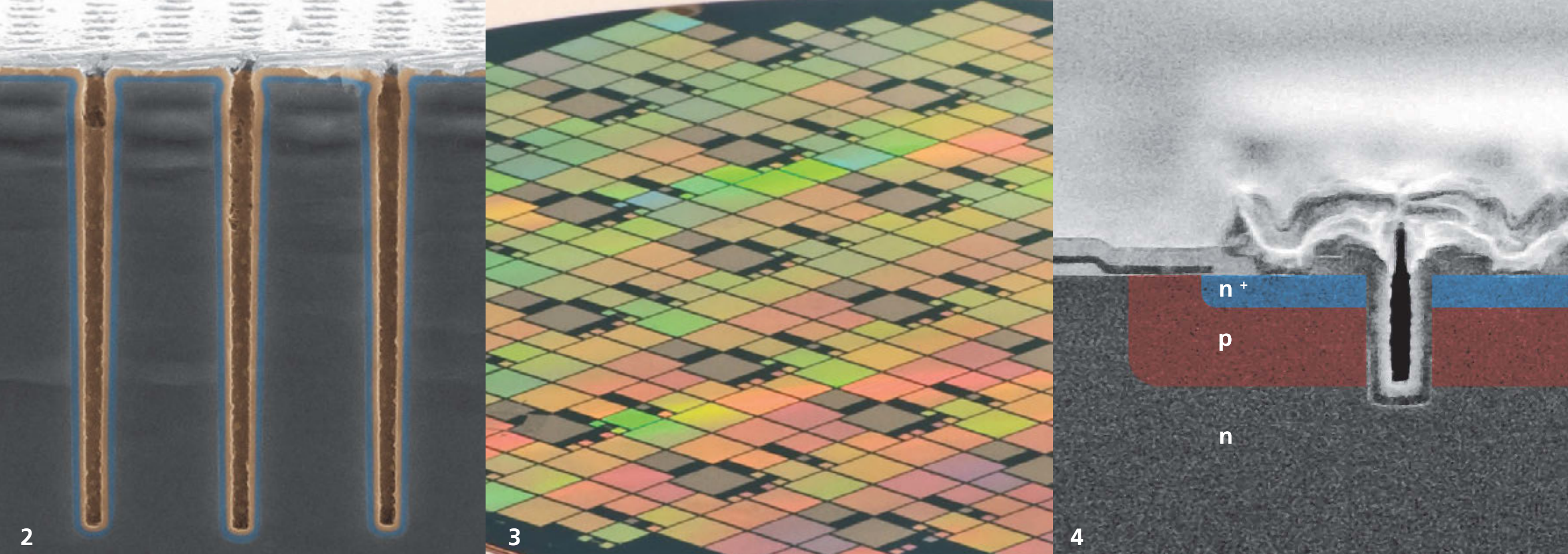




2 *High-voltage capacitors monolithically integrated into silicon using deep trench technology*

3 *Silicon wafer with monolithically integrated passive networks and test structures*

4 *LDMOS device with reduced $R_{DS,on}$ by combining trench gate technology with planar topology*

Device integration
Application specific integration concepts

- Silicon carbide power devices

  - Lateral and vertical power MOSFETs
  - Sensoric for harsh environments

- Passive devices for power electronics

  - High-voltage trench capacitors and temperature-stable resistors
  - Passive devices integrated on single chip
  - Glass capacitors

- Circuit protection devices

  - Controllable active fuses
  - High-current anti-fuses

- Integrated X-ray and UV sensors

Electrical characterization
Performance and reliability characterization

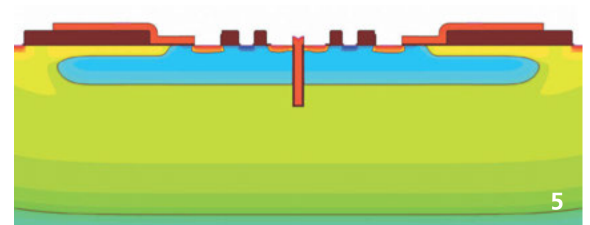
- Measurement of device performance

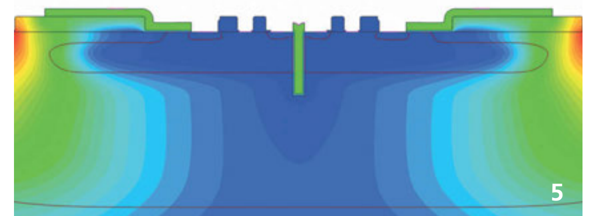
  - Forward conduction and blocking behavior of power devices
  - High-voltage capacitors (voltage, temperature and frequency characteristics)
  - Switching properties in non-volatile memories

- Statistical device reliability predictions considering individual failure mechanisms

  - Gate oxide integrity of transistors and capacitors
  - Retention time and endurance in non-volatile memories
  - Specific device qualification according to standards, e.g. automotive

- Process evaluation based on yield analysis





5 *Implementation of process simulation for prediction of electron device parameters*