Sensoristica radiazione X e UAV

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Materiali e tecnologie per la sensoristica

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Application Fields

- Astrophysics and Space Investigation
- Medical Imaging and Therapy
- Security and Environmental Monitoring
- In-Line Non-Destructive Inspection
Detector Fabrication

- Crystal growth of CZT Ingots (Boron Oxide Encapsulated Vertical Bridgman)

- Ingots and Wafer Cut

- Surface Preparation: Lapping and Polishing
Detector Fabrication

• Metallic Contacts Deposition and Patterning
  • Electroless Deposition (Au, Pt)
  • Chemical Etching
  • Photolithography
  • Sputtering (Au, Pt and Al₂O₃)

• Bonding
Detector Characterization

Optical Inspection:
- Surface
- Contacts
- Patternning

IR Transmission Microscopy:
- Defects Inspection
- 3D defects map reconstruction
Detector Characterization

Current/Voltage Characterization
- Low Noise Electric Measurement Setup

Spectroscopic Characterization
- Oscilloscope
- Pulse generator
- Analogic detector read-out system

Keithley sourcemeter: ±1100V
Keithley picoammeter: < 1 pA
Pixelated detectors for imaging

- Pixelated Detectors
  - Detector Development Program of ESRF (Grenoble – FR)
  - Collaboration with RAL (Didcot – UK)

Fine-pixel detectors:
- **75 µm pitch**, 256*256 pixels, 20x20 mm²
- **55 µm pitch**, 256*256 pixels, 15x15 mm²

→ electroless and sputtered Au and Pt blocking contacts
3D drift-strip detectors for gamma-ray detection for space applications

- 3D-CZT Module (3DCa™) for spectroscopic imaging, timing and polarimetry in hard X-/soft \( \gamma \)-rays satellite mission
  - Spectroscopic imaging & timing
  - Polarimetry

Segmented cathode

48 anode and drift stripes

\( \text{Al}_2\text{O}_3 \) passivation (in collaboration with PED group)
Linear array detectors for in-line inspection scanners

- Detector Response Simulation
  - Photon-matter interaction
  - Electric Field Simulation
  - Carrier Transport
  - Signal Generation

- Spectrum Correction
  - Pileup Correction
  - Unfolding Correction
In-line Scanner for Wood Panel Density (‘Ripallet’ project)

Five density measure units composed by:
- 1 X-ray tube
- 2 collimators
- 1 CZT detection module

Real-time density control

Wood panels
**X-drone**

- **Dangerous nuclear source detection in hash environment (timber yard, landfill, industrial plants) and minimization of human operator dose**

- **Teleguided vehicle (UAV) equipped with γ-ray CZT-based sensor**

- **Prototype:**
  - Micro-UAV (chip, lite, optimal payload)
  - CZT-based sensor (compact, robust and RT spectroscopy)

- **From Prototype to Commercial product (sold by CAEN)**