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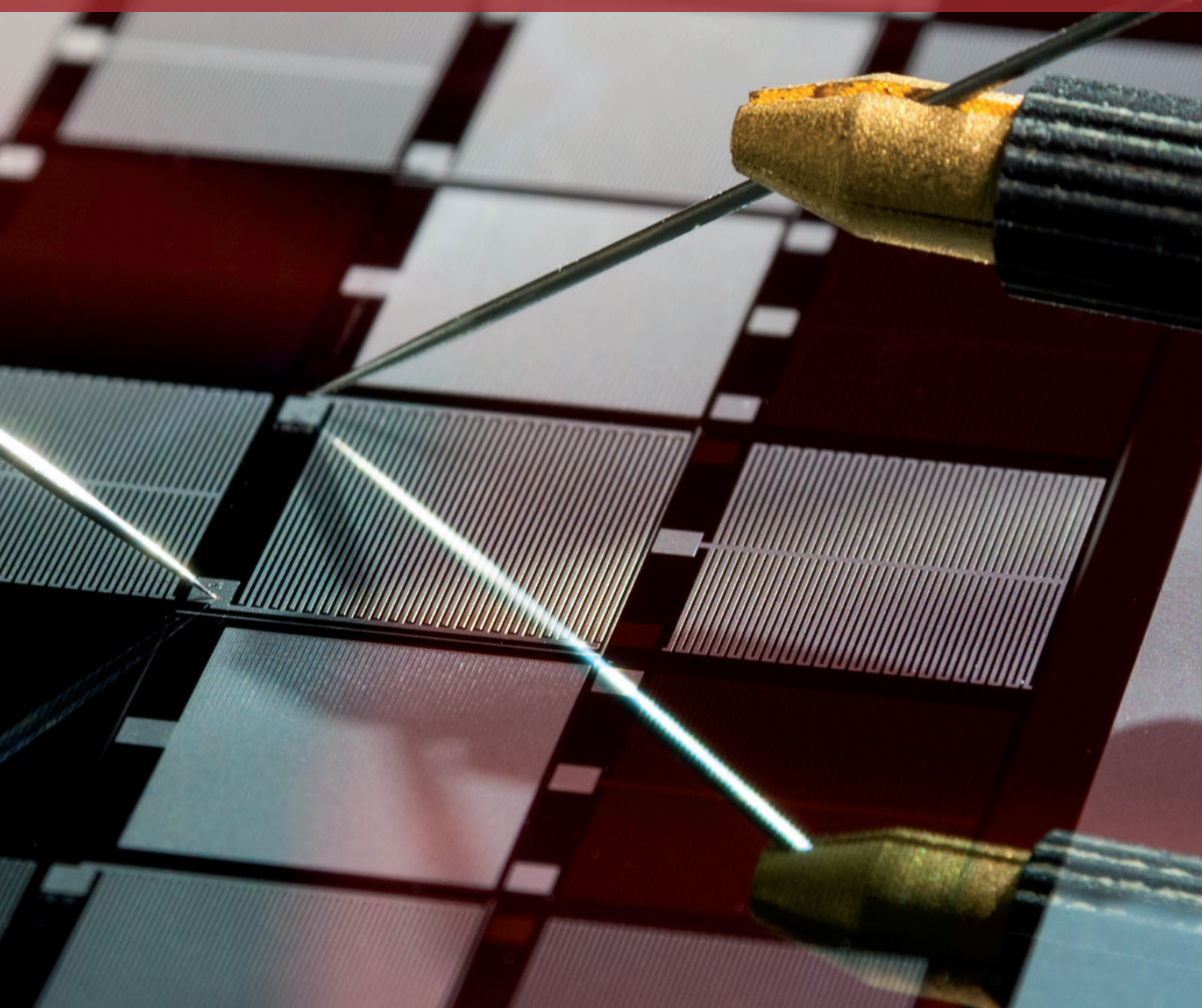
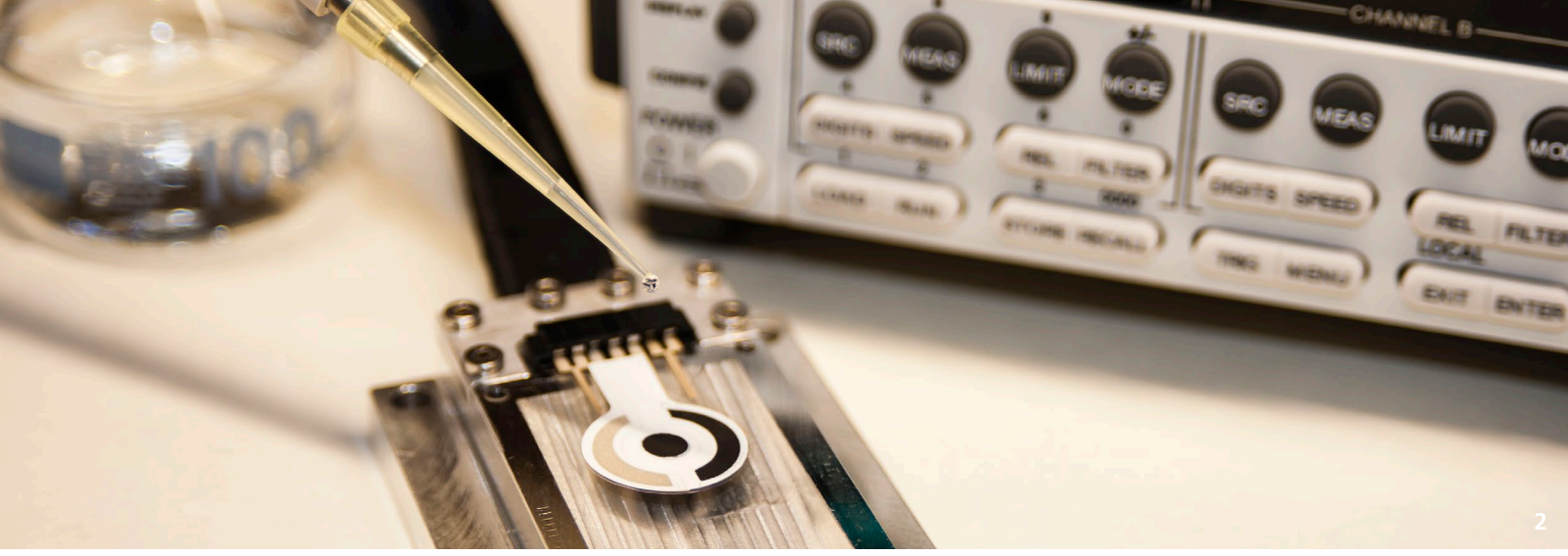
FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY

# THIN-FILM SYSTEMS



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# THIN-FILM SYSTEMS

Due to limitations in areal scalability and high cost per area, conventional silicon technologies do not meet the cost demands of large-area electronic systems. Furthermore, assembly of discrete devices is not an option when it comes to larger numbers like in distributed sensor arrays or display backplanes.

Thin-film electronics fills the gap in between those technologies offering

- Ultrathin form factor
- Mechanical flexibility
- Large-area coverage, and
- The prospect of employing low-cost fabrication techniques like printing or roll-to-roll processing

In close cooperation with our customers and research partners we develop materials, processing techniques, and devices for application in thin-film systems.

**COVER PHOTO**

*Metal oxide thin-film transistors under test*

2 *Screen-printed electrolyte sensor in test setup*

3 *Micrograph of ZnO-based thin-film transistors*

### Materials and Processing

We utilize conventional techniques like vacuum-based sputtering (PVD) or plasma-enhanced chemical vapor deposition (PECVD) for deposition of elemental (Si, metals) as well as metal oxide (ZnO, ITO, $Al_2O_3$) materials which both can give a complete materials toolbox for active devices, sensors, passives, and circuit periphery.
Furthermore we strive to replace conventional techniques by solution-based coating and direct printing techniques. Therefore we develop and formulate nanomaterials and molecular precursors into stable inks and investigate deposition and conversion into functional layers.

### Devices and Systems

The integration of functional thin-films into devices and applications is the second focus of our activities. Large-area distributable sensors, addressing and evaluation circuitry, small TFT power drivers and control circuitry are the building blocks that lead to novel integrated thin-film systems for energy, automotive, industrial, consumer, and lighting applications.



# COOPERATION

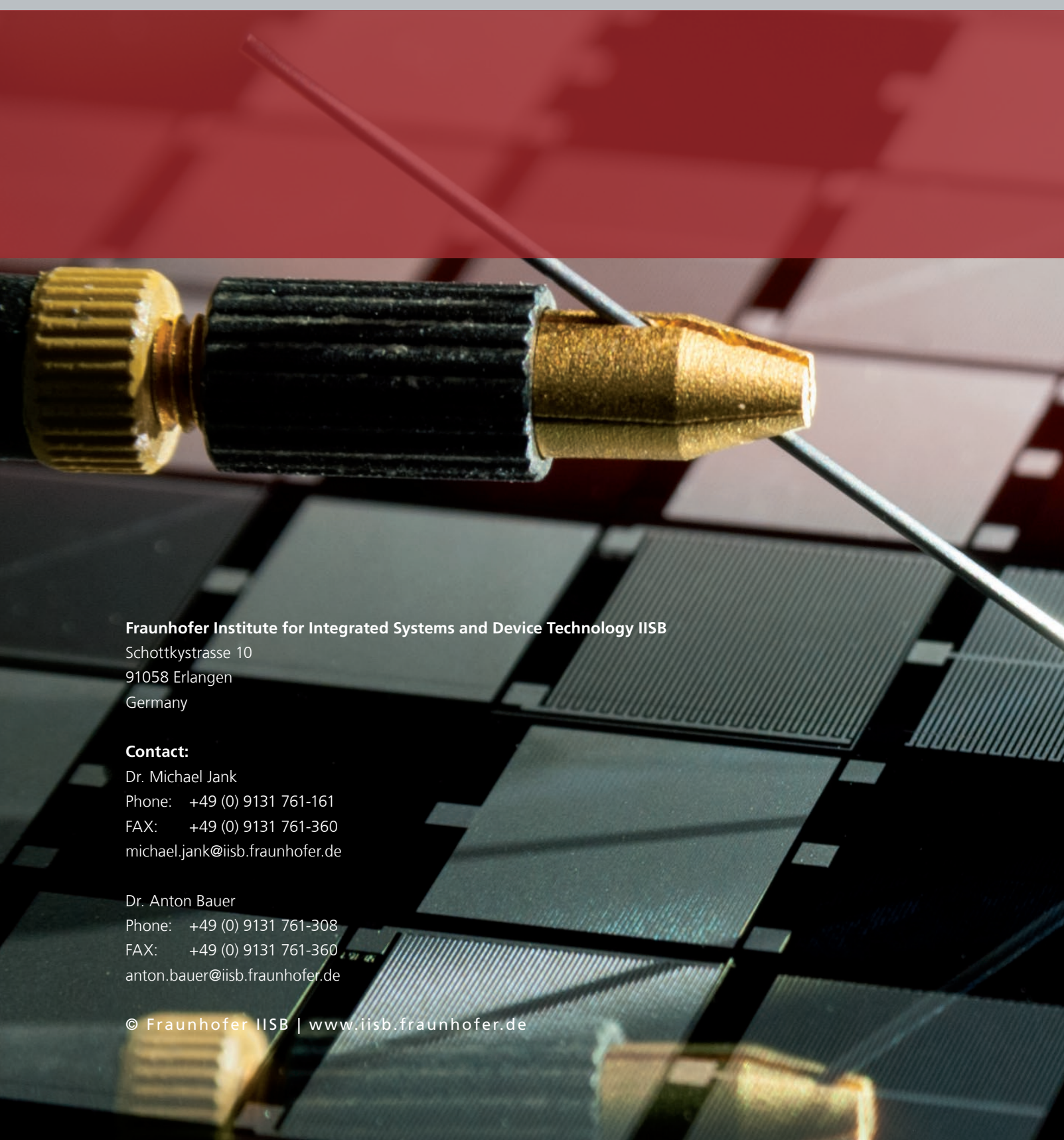
We offer long-term experience proven by successfully conducted bilateral and multi-partner research activities.

- Contract based
  - Research and development projects
  - Application demonstrators
  - Analytical and measurement services
  - Feasibility studies
  - Consulting

- Publicly funded research projects
  - On regional, national and international level
  - Concept development and partner selection
  - Proposal coordination and writing
  - Research and development work
  - Coordination activities

**Services and Solutions**

| | Techniques | Characterization |
|---|---|---|
| **Nanomaterials synthesis, ink formulation** | Gas-phase or wet chemical synthesis, ball milling, ultrasonication, filtering, high-speed centrifugation | Viscosimetry, high-speed centrifugation, dynamic light scattering (DLS), thermo- gravimetric analysis (TGA/DSC) |
| **Thin-film deposition and annealing** | Ink jet, screen printing, spin coating, spray coating, spray pyrolysis, plasma treatment, DC and RF sputtering, e-beam evaporation, Plasma enhanced CVD, atomic layer deposition, furnace annealing, hot plates | Scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS), X-ray diffraction (XRD), atomic-force microscopy (AFM), ellipsometry |
| **Device and application development** | Full 200 mm CMOS line, glovebox line, combination of printed devices and conventional electronics, pre-processing of test structures | Electrical characterization in ambient air, inert atmosphere and vacuum |



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