in cooperation with

ARKEMA PIEZOTECH

ARMOR SMART FILMS

JOANNEUM RESEARCH MATERIALS

PyzoFlex®

sense your future

SHAPING THE FUTURE, TOGETHER

PyzoFlex®

At JOANNEUM RESEARCH, ARKEMA Piezotech®, and ARMOR Smart Films, we harness our combined expertise to deliver cutting-edge sensor systems and advanced smart materials.

Partnership

- Collaboration covers the entire value chain: from material formulation and sensor design to scalable production and system integration.
- Tailored solutions for diverse industries, leveraging each partner's unique expertise.

Key Technologies

- **JOANNEUM RESEARCH - PyzoFlex® Technology:** High-precision polymer sensor technology adaptable for various market segments.
- **ARKEMA Piezotech® for electro-active Polymers:** Sensory functions sensitive to temperature, pressure changes, and vibrations, adding flexibility and efficiency to printed electronics.
- **ARMOR Smart Films for Manufacturing:** Expertise in scaling sensor fabrication for seamless integration into production processes from research to mass production.

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Core Features

- **High Responsiveness:** sensors convert mechanical deformations, impacts and vibrations over a broad frequency range in real-time into electrical signals.
- **Versatile Hybrid Integration:** the technologies are compatible to a variety of surfaces, structures, and interfaces, enhancing product functionality.
- **Sustainable Solutions:** energy-efficient sensors enable autonomous energy harvesting systems.

Application Areas

- **Industrial Sensing:** Condition monitoring, predictive maintenance and structural health monitoring.
- **Healthcare:** Monitoring of various vital parameters such as pulse and respiratory rates.
- **Smart Mobility:** Enhancing secure human-machine interfaces, impact sensors, glass break sensors etc
- **Smart Living:** Developing systems to enhance private and public spaces with sensory functions, e.g. intelligent floors with fall detection.
- **Consumer Electronics and Sports:** Sensors for flexible and bendable interfaces (touch inerfaces, machine control systems), and terrific solutions for versatile applications.

Poling and characterization Systems

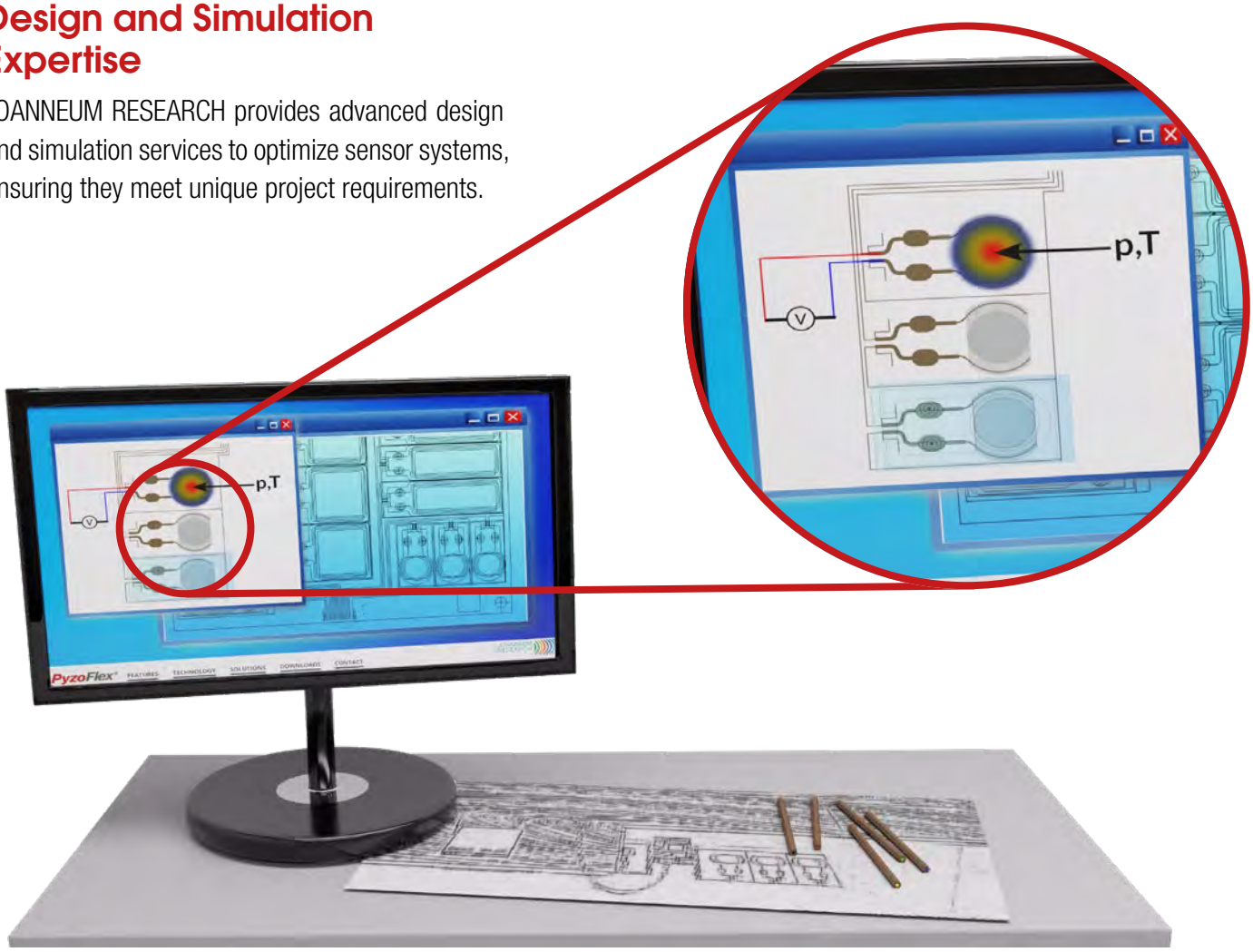
Hybrid integration

Application Example Smart Floor

PyzoFlex®

Design and Simulation Expertise

JOANNEUM RESEARCH provides advanced design and simulation services to optimize sensor systems, ensuring they meet unique project requirements.



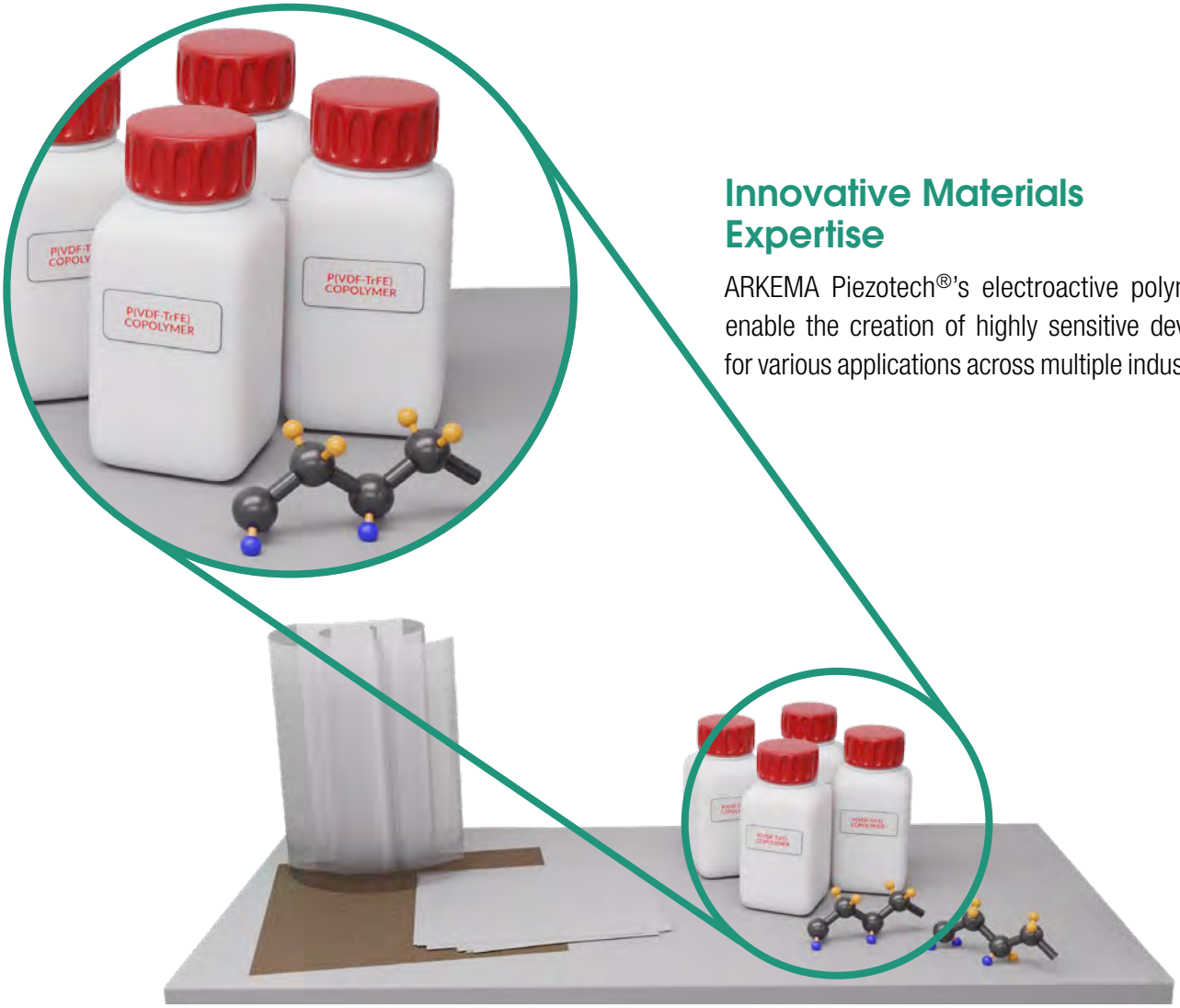
Design und Simulation Services

- Optimization of sensor geometry, substrate material selection, and screen-printing inks.
- Finite element simulations considering coupled mechanical and electrical properties of integrated transducers (integrated foil sensors).
- Application driven and tailored sensor systems through comprehensive simulation and hybrid integration.
- Prototyping and characterization of simulated designs for validation.

ARKEMA

PIEZOTECH®

piezotech.arkema.com



Innovative Materials Expertise

ARKEMA Piezotech®'s electroactive polymers enable the creation of highly sensitive devices for various applications across multiple industries.

ARKEMA Piezotech® Electroactive Polymers

- Available in powders, inks, and films for printed electronics.
- High sensitivity to convert vibrations, impacts, and deformations into electrical signals.
- Low environmental impact and high mechanical flexibility, ideal for a range of applications like automotive, healthcare, acoustics, and sports.

Material Benefits

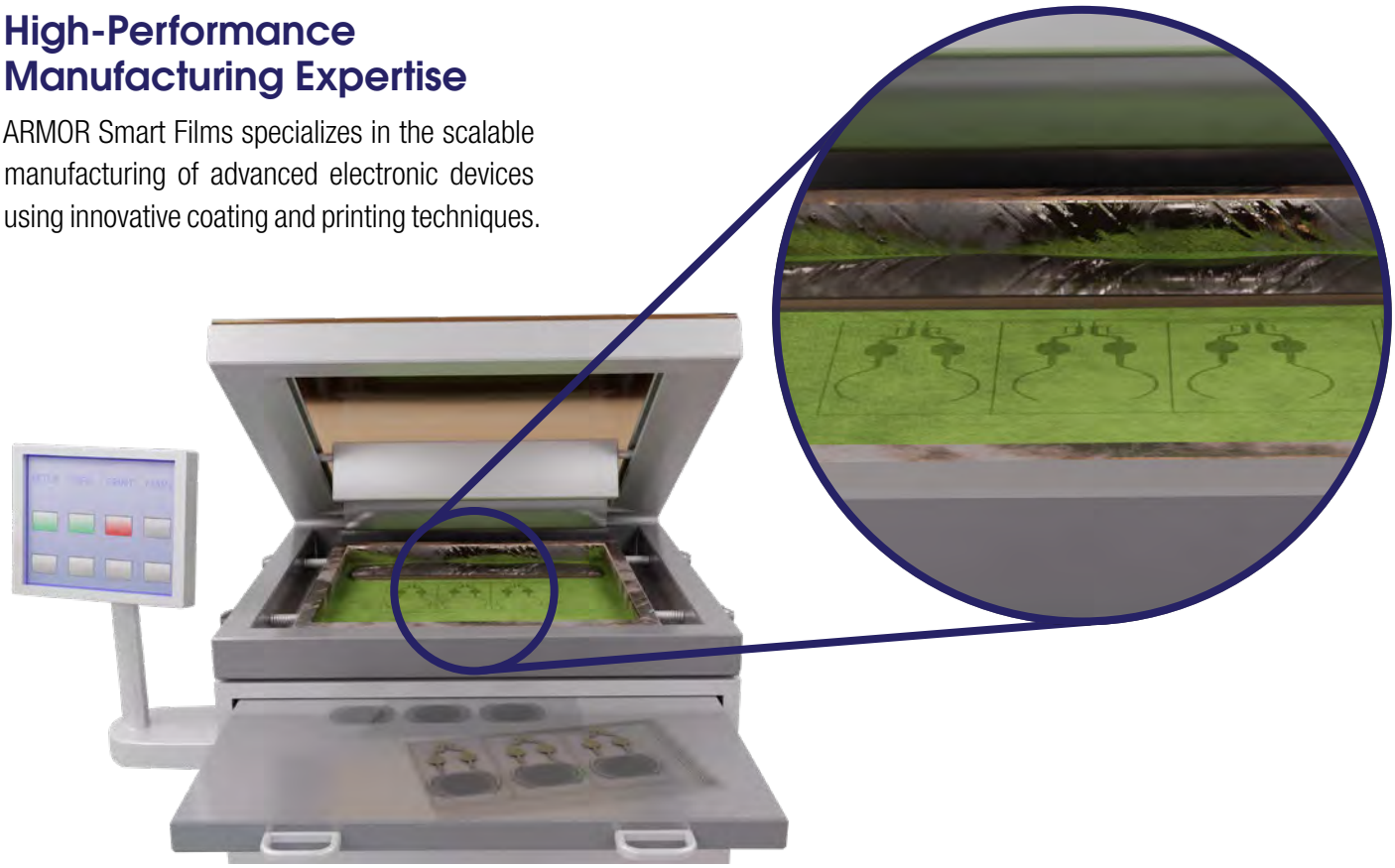
- Enables motion or thermal energy conversion into electricity.
- Printed, flexible, lightweight, and cost-efficient solutions.
- Suitable for secure man-machine interfaces, structural control, and shock sensors.

ARMOR SMART FILMS

www.armor-group.com

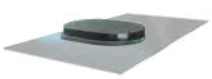
High-Performance Manufacturing Expertise

ARMOR Smart Films specializes in the scalable manufacturing of advanced electronic devices using innovative coating and printing techniques.



ARMOR Smart Films Production

- Large-scale production of electroactive devices, energy generation/storage, and printed electronics.
- Sheet-to-sheet and roll-to-roll screen printing processes for scalability and high-quality output.

Substrate	1st Electrode	Active Material	2nd Electrode	Connections
				
Plastic, paper, textile, glass, metal, transfer foils ...	PEDOT: PSS (conductive, transparent polymer)	Copolymer: PVDF:TrFE-Ink **patented!**	PEDOT:PSS (for semi-transparent sensors) Carbon	Ag lines for connection to read-out electronics

From material formulation and sensor design printed piezo element - to scalable production and system integration (sensor system)

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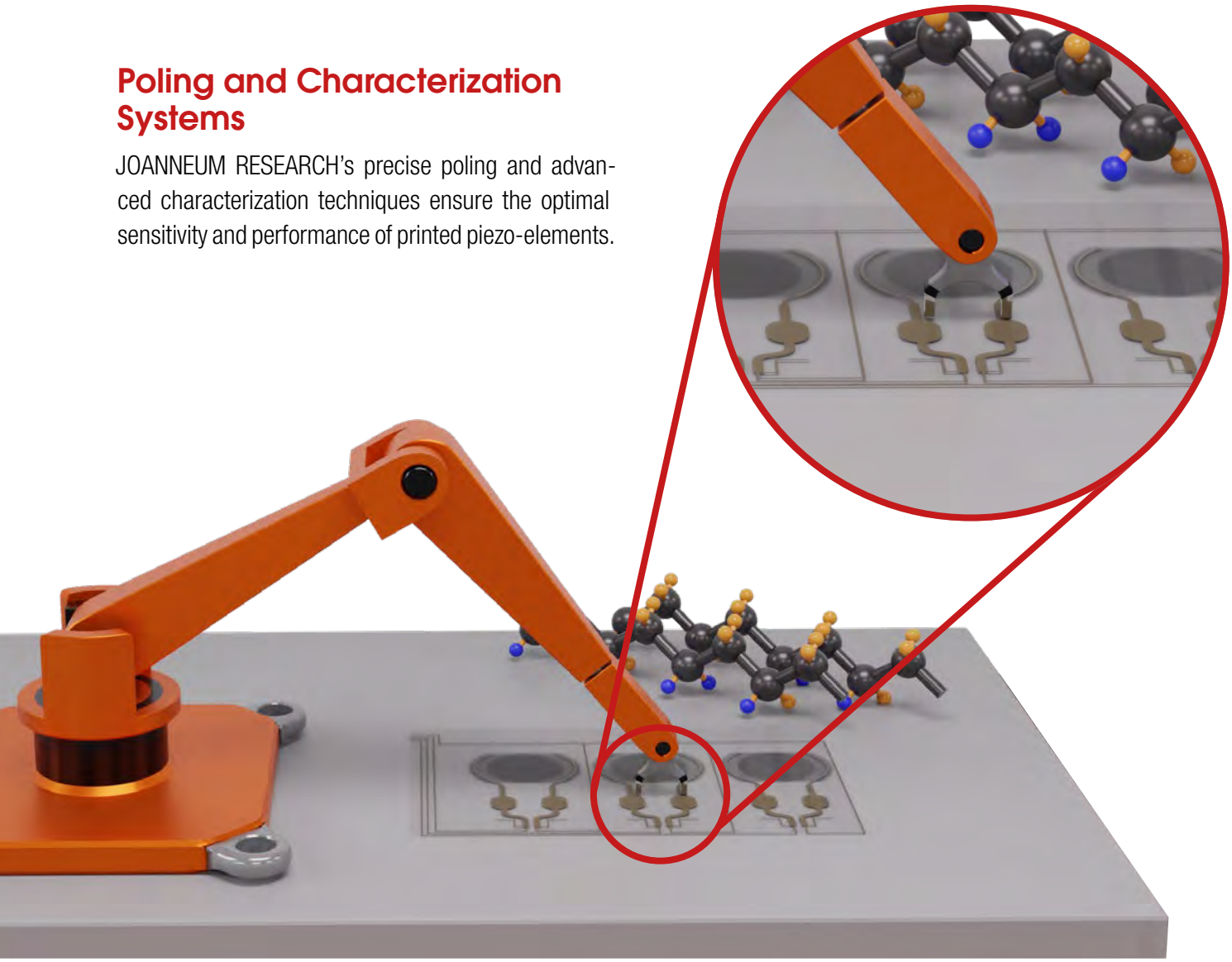
Poling and Characterization Systems

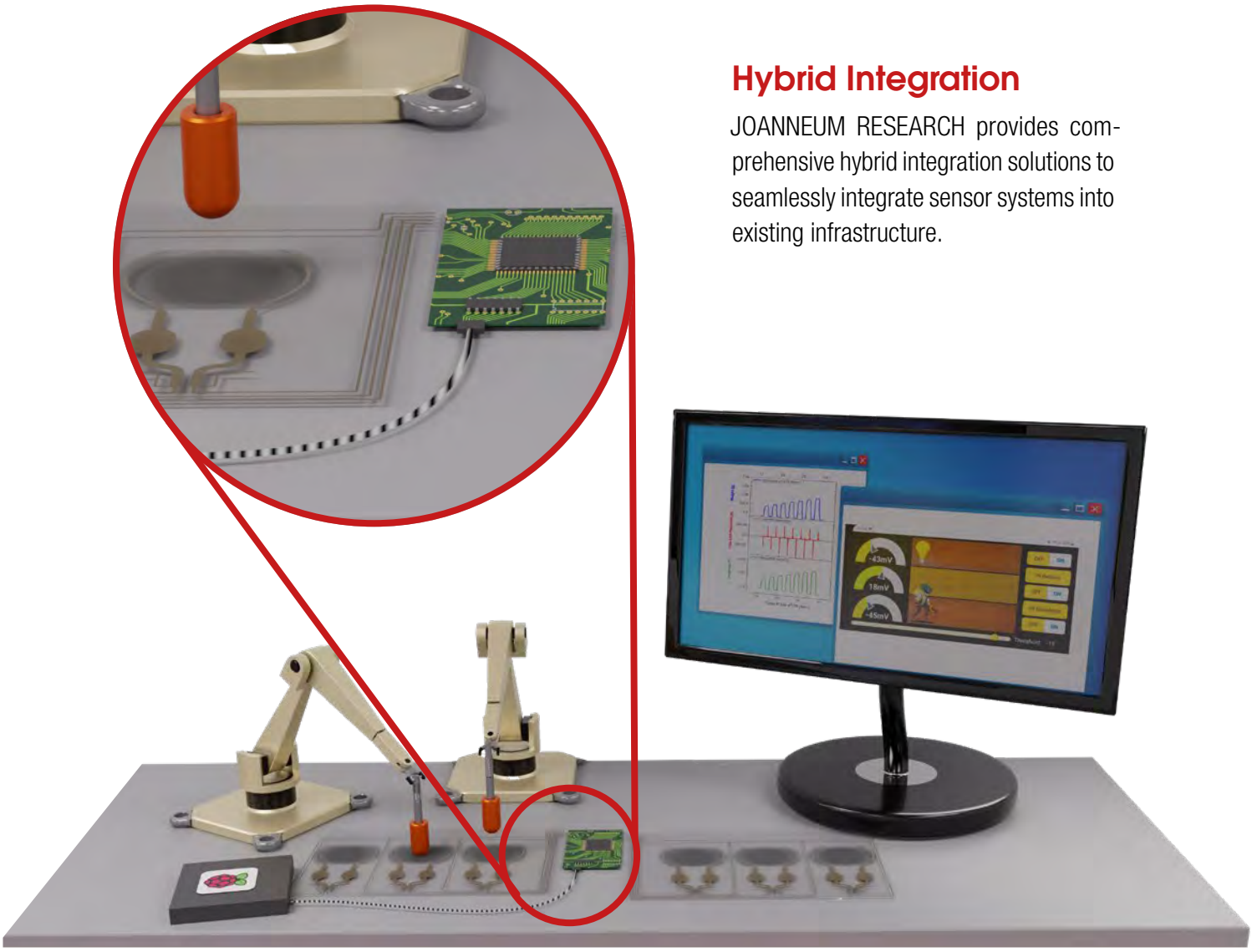
JOANNEUM RESEARCH's precise poling and advanced characterization techniques ensure the optimal sensitivity and performance of printed piezo-elements.



Precise Poling of Ferroelectric Materials

- Hysteresis poling for in-situ calibration and quantitative characterization of sensors.
- Precise alignment of molecular dipoles, optimizing sensor sensitivity and signal response.
- Quality control measure for sensor pixels.

PyzoFlex®

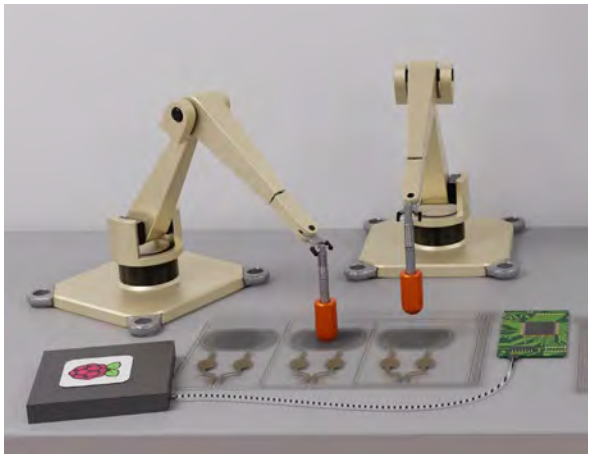


Hybrid Integration

JOANNEUM RESEARCH provides comprehensive hybrid integration solutions to seamlessly integrate sensor systems into existing infrastructure.

Comprehensive Hybrid Integration Solutions

- Expertise in bonding (crimping, conductive gluing, riveting, etc.), hardware integration, signal processing, and software development.
- Seamless integration of flexible or stretchable piezo-elements with various/specific electronic components.
- Integrating sensors on diverse materials like stone, wood, leather, fabric, or metal.



Sensor System Design

- Electronics: advanced circuit simulation, design and printed circuit board development (Altium Designer)
- Firmware: control peripherals, signal pre- and post-processing, data transmission on different systems: µCs STM32, ESP32, Raspberry PI, etc.
- Design and manufacturing of mechanical components (e.g. housings)
- Application adapted system assembly

Communication Interfaces

Reliable communication interfaces for continuous and unrestricted data exchange including

- wireless (e.g. Bluetooth, Wi-Fi, LoRaWAN)
- wired (Analog: IEPE; or Digital e.g. Modbus, CAN, Ethernet)

options, ensuring reliable online data transmission even in harsh environments.

Application Specific Software Development

- Intuitive graphical user interfaces (GUI) for effortless control and analysis of sensor data
- Live data transmission and visualization for mobile and desktop users

Get ready to explore the incredible world of machine learning and AI! This amazing technology can be used to tackle a wide range of tasks.

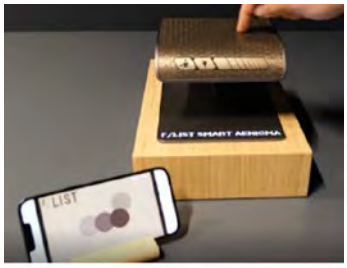
PyzoFlex®

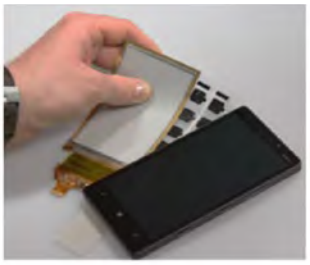
Consumer Electronics

Human-Machine Interface (HMI) – Innovative Controls That Inspire

How can control elements remain invisible in modern designs while still delivering full functionality?

Our PyzoFlex® systems open up new possibilities! They integrate invisible, multi-functional controls into flexible and elegant surfaces, ideal for high-quality input consoles in smart cities and smart living environments. Whether it's a touchpad or a visual display, PyzoFlex® transforms your ideas into durable, customizable, and lightweight control elements that seamlessly blend into any design.





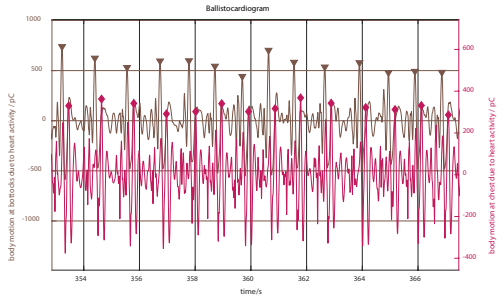
f-list.showpad.com

Health and Well-being Monitoring – Comfort Meets Precision

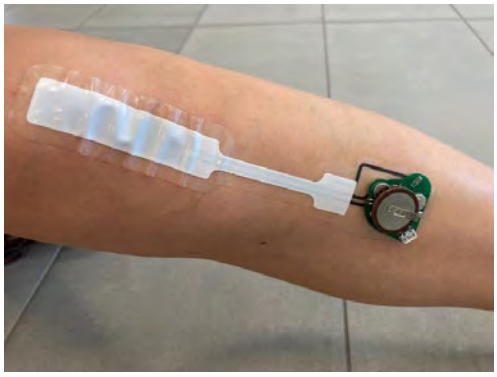
Do you want to measure vital signs with high accuracy without sacrificing comfort?

PyzoFlex® sensor patches make it possible! They accurately capture vital signs such as heart and respiratory rates, ballistocardiography signals, and joint movements in real-time. The reusable and rechargeable patches transmit collected data wirelessly via Bluetooth. Perfect for innovative solutions in health and sports sectors where comfort and reliability go hand in hand.

Health & Wellbeing



Measurements with 2 sensors at different positions (chest & buttocks) Time difference of pulse wave for Ballistocardiogram



Patch with electronics
Electronic PCB contains:

- *Flat Sensor contacts*
- *PyzoFlex analog front end*
- *Bluetooth antenna*
- *Recharchable battery*
- *Micro USB plug*

Smart City
Smart Living

Smart City & Smart Living – data protection-compliant sensory solutions for private and public spaces

Designed to optimize space management and to track most various activities, the PyzoFlex Smart floor system offers unparalleled accuracy while ensuring privacy and minimal intrusion.

Whether private places (apartments) or public areas (flag ship stores) - with PyzoFlex® sensor systems in floorings you can track a wide variety of processes or activities –

- an invisible alarm system in museums
- fall detector in assisted living
- customer flow analysis in stores.

A floor with ultra-thin printed piezo elements is being developed for connected home applications. These elements act as pressure switches to control lighting, heating, etc. and can detect the presence of people and distinguish them from other pressure sources/mechanical excitations. All the electronics are integrated on the plastic film to enable a smooth, flat and lightweight floorboard and to avoid cables.

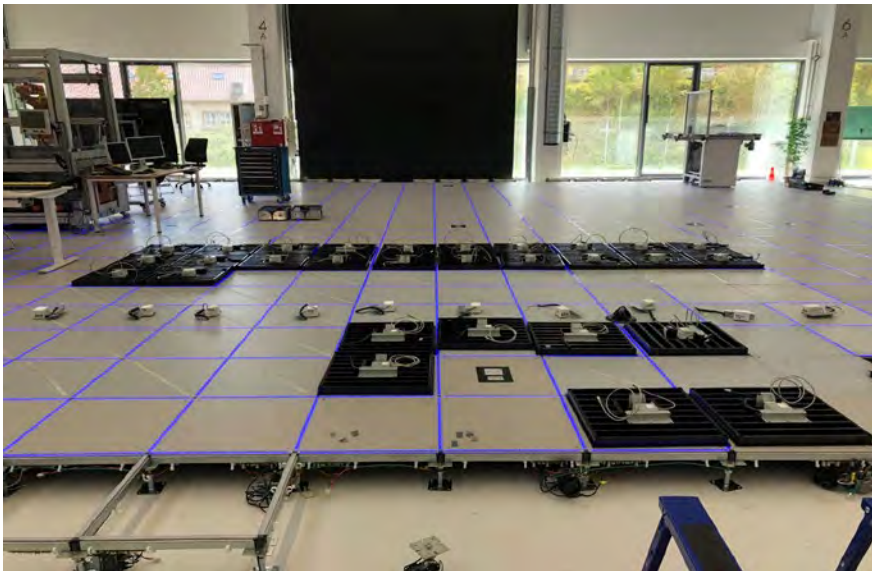
PyzoFlex®

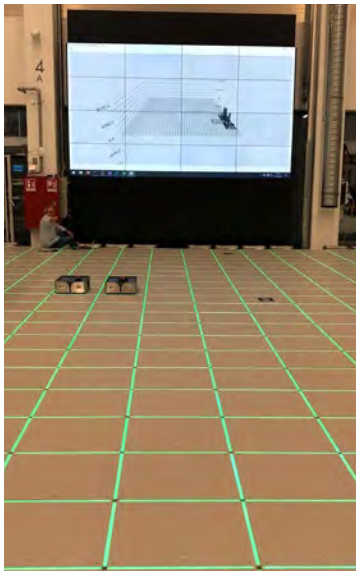
Industrial Sensing

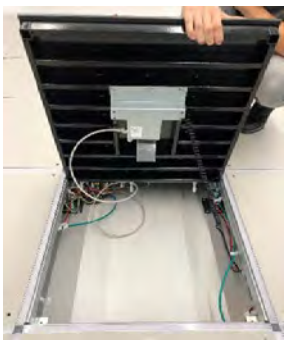
Industrial Sensing – Precision That Makes a Difference

Whether predictive maintenance, condition- or structural health monitoring - our PyzoFlex® sensor systems offer solutions for a wide range of industrial processes - as they are easy to install, consume little energy and can measure vibrations and other events in real time.

As an important part of convertible manufacturing, the »intelligent floor« infrastructure platform supports the flexibilization of production processes, such as the energy supply of mobile means of transport or the detection of objects in real time. The sensor element must be extremely flat so that it can be integrated between the floor covering and the floor panel and enables:







- Optimizing the spatial resolution (compared to load cells)
- Spatial accuracy
- Response behavior
- Measuring intervals
- Elimination of privacy issues

PyzoFlex® seems to have the best potential for fulfilling these requirements and revolutionizing the measurement of pressure distribution in (industrial) flooring applications.

Bosch/Arena 2036

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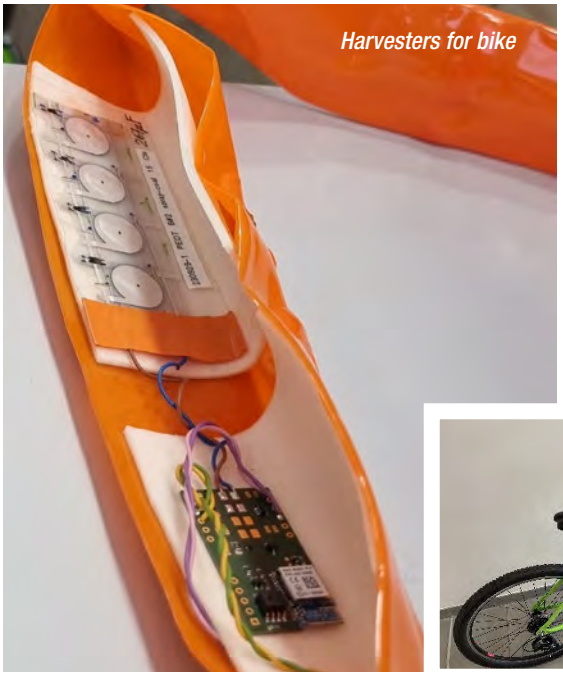
Smart Mobility

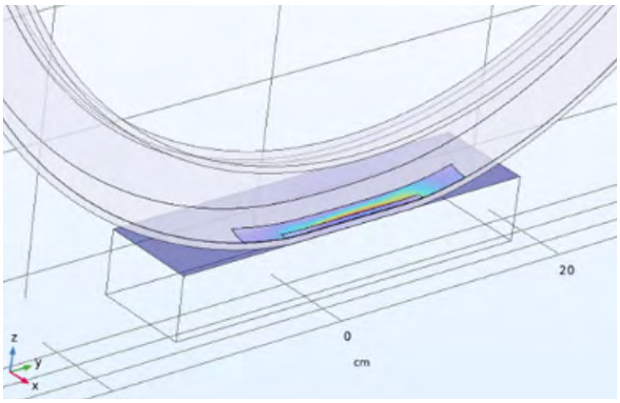
Energy Harvesting – Rethinking Sustainability

How can you generate energy from everyday movements?

Discover the potential of our PyzoFlex® technology! Our innovative printed piezo-elements convert mechanical deformations into usable energy. Whether it's tire deformations in vehicles or bicycles - PyzoFlex® provides the energy needed for applications like real-time tire pressure monitoring, wireless data transmission, and more. Taking smart mobility and renewable energy to the next level.

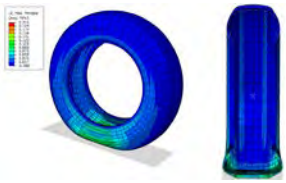


Harvesters for bike

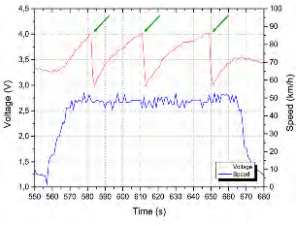


App for Tyre-Pressure-Feedback

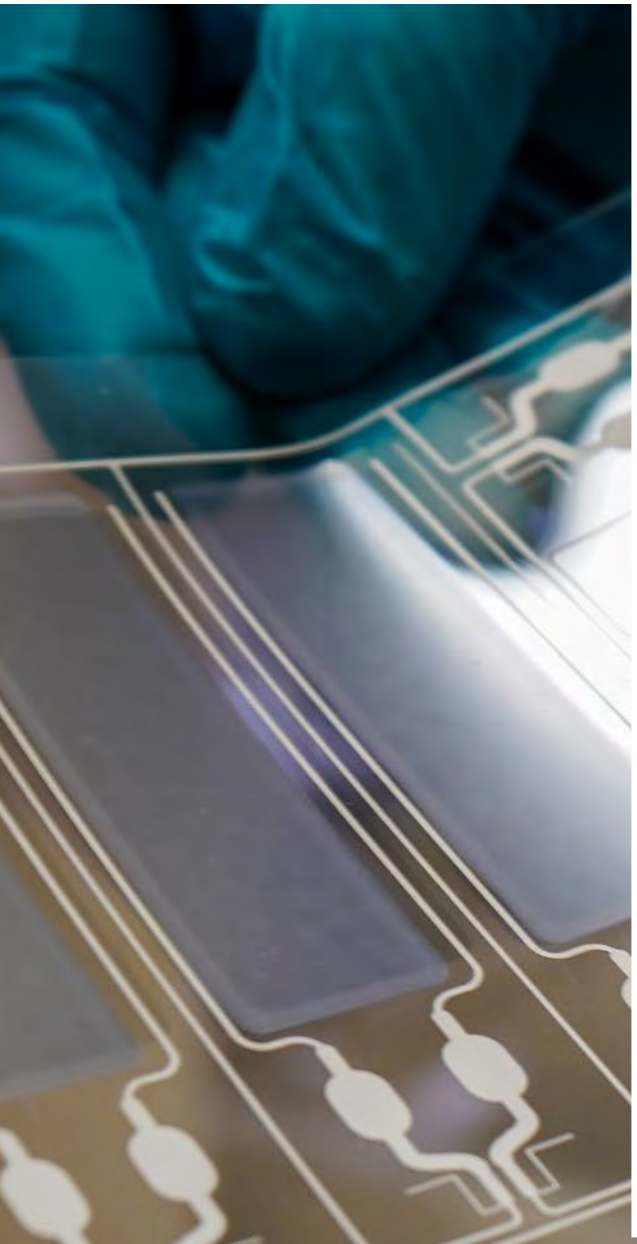
Mechanical deformation as energy input



Harvester max



PyzoFlex®



Customized Solutions

Every project is unique!

For this reason, each of our projects is unique and we develop a customised solution for your application idea at the highest level - from

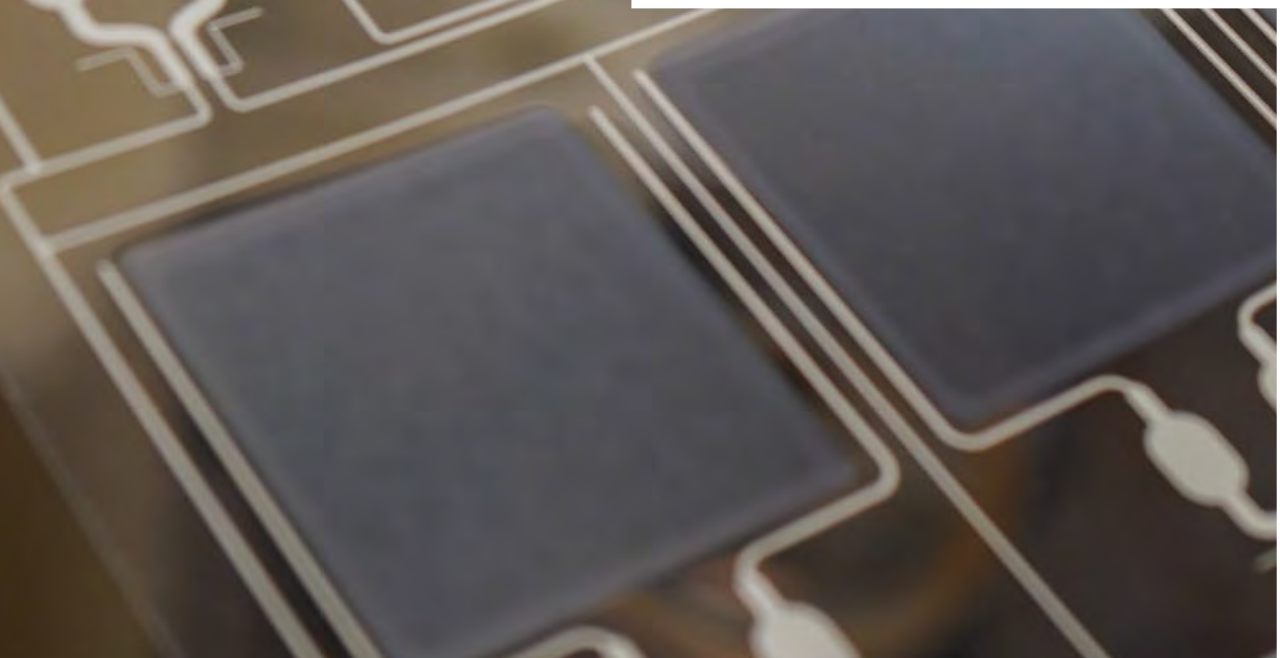
- Sensor geometry
- Substrate & material selection
- Hybrid integration (bonding, hardware, communication)
- Software & App

ensuring your product meets the highest performance standards.

Our end-to-end expertise allows the optimization of the geometry of the printed piezo element as well as the overall sensor system design, mechanical and electrical aspects of our sensor technology perfectly matching your specific application.

Together with you, we develop innovative, high-performance sensor systems that solve your specific specific specific challenges, and experience, how JOANNEUM RESEARCH revolutionizes industries with innovative concepts and solutions based on smart sensor technologies.

Visit our website or contact us directly to explore how we can together bring your next project to life.



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Further information as well as results of PyzoFlex® developments in various projects can be found here

JOANNEUM RESEARCH

PyzoFlex®

SYMPHONY

Smart2Go

MULTIMOLD

SMART@SURFACE

JOANNEUM RESEARCH MATERIALS

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https://piezotech.arkema.com/en

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