

NEXT-GENERATION MICROSCEAL THERMAL ENERGY HARVESTING AND COOLING TECHNOLOGY

TRL
4

As electronics shrink and power demands move towards distributed and autonomous systems, thermal management and microscale power generation are becoming critical challenges. The Thermoelectric Micro Column Array Device provides a scalable and integration-ready solution for energy harvesting and localised cooling in advanced electronic systems.

The device uses a structured array of transparent thermoelectric semiconductor micro-columns embedded within an insulating matrix and integrated between conductive layers. This architecture enables efficient conversion of thermal gradients into electrical power while allowing precise control of heat flow at micro- and nanoscale dimensions.

+ Features

- Micro-column array architecture: Transparent thermoelectric semiconductor micro-columns embedded in an insulating matrix to enhance thermal-electrical coupling.
- Layered device design: Glass substrate with top and bottom transparent conductive layers for power generation or cooling operation.
- Manufacturing compatibility: Suitable for microfabrication workflows and scalable to high-density micro-array

+ Key benefits

- Compact form factor for microelectronic integration
- Fully transparent device
- Enhanced out-of-plane energy conversion efficiency
- High design versatility through tuneable geometry and materials
- Increased output power within small device footprints

+ Suggested applications

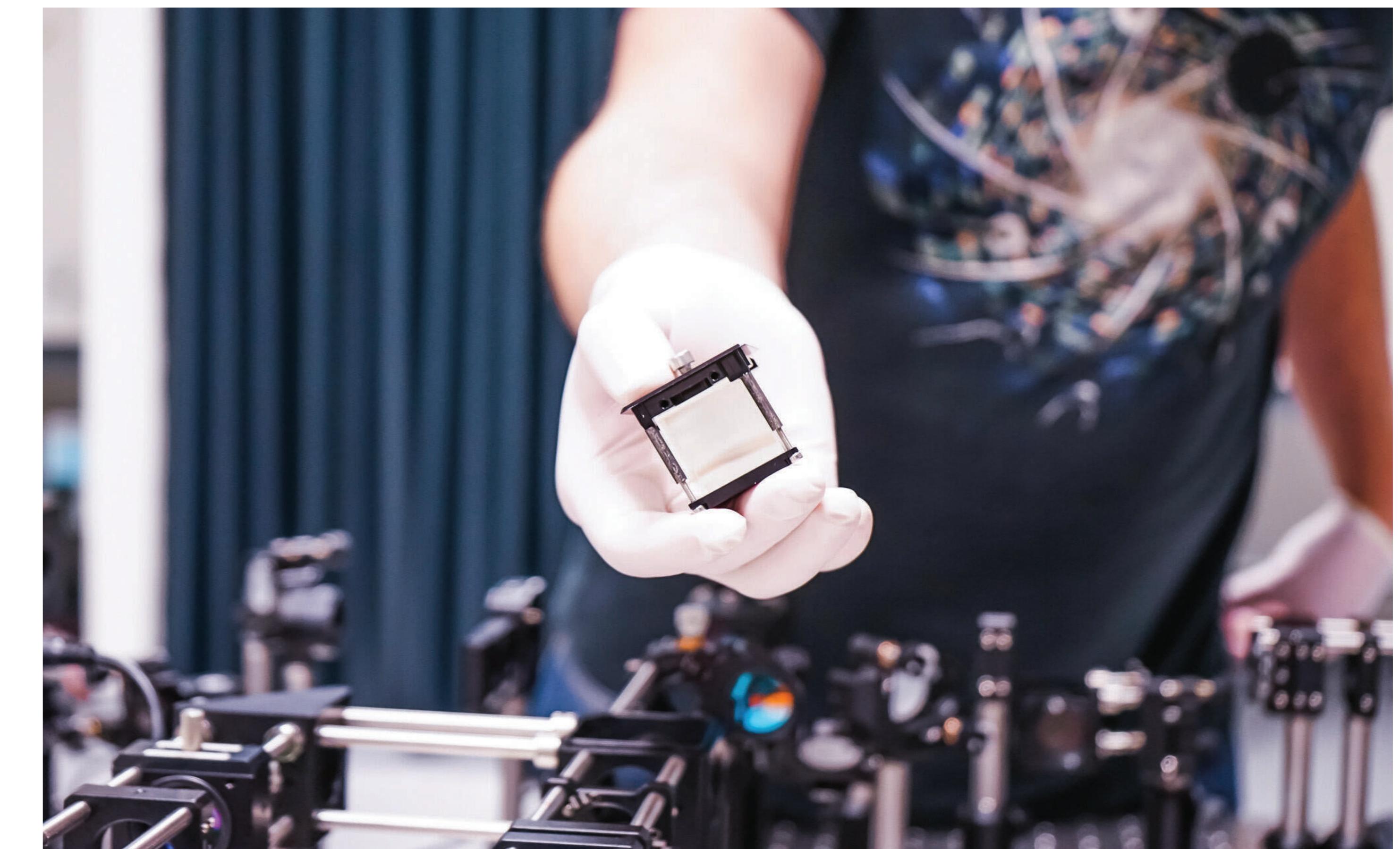
- Powering low-energy IoT devices
- Precision cooling and localised temperature stabilisation

+ Patent status

Initial publication ISR A1

+ Inventors

Carlos José Macedo Tavares, Pedro Anacleto, Sascha Sadewasser, Bruno Gonçalo Neiva Fernandes



YOUR WORLDWIDE PARTNER FOR NANO-ENABLED SOLUTIONS

At the forefront of nanotechnology discovery and advancement

01 SCIENCE

Answering fundamental questions about nanoscale phenomena.

02 TECHNOLOGY & SERVICES

Turning science into societal solutions with tailored, advanced support.

03 SOCIETY

Connecting science with citizens to inspire engagement and trust.

04 TALENT

Empowering people to innovate, lead, and shape the future.

For more information:

office@inl.int

www.inl.int
Av. Mestre José Veiga,
Braga 4715-330, Portugal

Follow us:

- [@inlnano](https://www.linkedin.com/company/inlinternationaliberiannanotechnologylaboratory)
- [@inlnano](https://www.instagram.com/inlnano)
- [@INLInternationalberianNanotechnologyLaboratory](https://www.facebook.com/INLInternationalIberianNanotechnologyLaboratory)

