جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

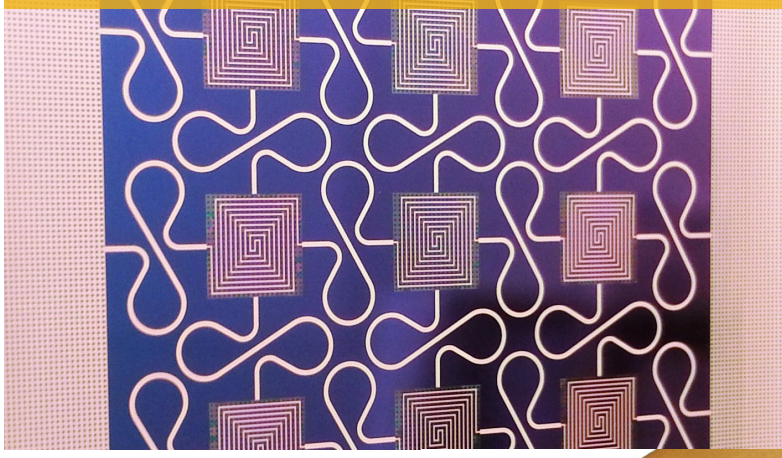
Smart Thermal Patch for Adaptive Thermotherapy

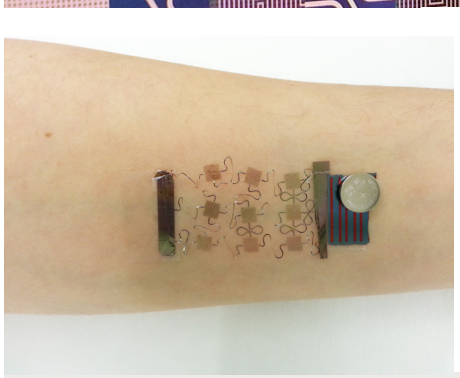
A battery-powered, stretchable patch with wireless heat management

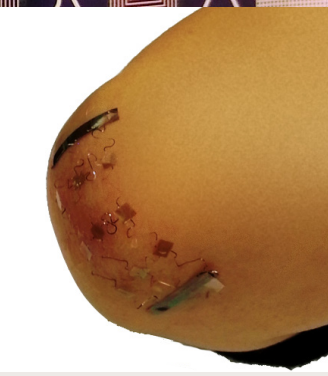
KAUST faculty and researchers have demonstrated a smart thermal patch which can be used for thermotherapy for pain management, that is adaptive and user-friendly. The patch provides significantly greater control over applied heat than current chemical-based methods for applications including thermotherapy of patients suffering from arthritis or certain forms of cancer. As an example, recent studies have shown that over 70 million people suffer from arthritis—three million of whom are children.

The technology developed is revolutionary as it is extremely stretchable (800%), non-polymeric and low-cost, using a metallic thin film copper (Cu) -based technology that is flexible and non-invasive. The heat can be precisely controlled by a wireless bluetooth connection and energy is supplied by rechargeable batteries. Stretchability allows the size of the device to be changed as needed to fit a small area (e.g. finger) or a large area (e.g. knee).

TECHNOLOGY OPPORTUNITY







Benefits

- Metallic nature of film allows it to be durable and reusable.
- Stretchable and can be contracted back to its original form allowing tunable size.
- Adaptive technology that measures the temperature of the inflamed area and calibrates the temperature as needed.
- Can be wrapped around limbs and digits in a much more precise manner than existing technologies.
- Usage data can be monitored remotely by a doctor or healthcare professional.
- Precise temperature control using smartphones or mobile gadgets.
- Rechargeable battery.

Applications

- Smart medical devices
- Pain management
- Thermotherapy

Opportunity

This technology is part of KAUST's technology commercialization program that seeks to stimulate development and commercial use of KAUST-developed technologies.

Opportunities exist for joint development, patent licensing, or other mutually beneficial relationships.

For More Information

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Technology Details

Every day, people experience discomfort due to pain and strain. Typically, they use chemical-based off-the-shelf thermal patches which come in various sizes based on pain locations and affected area. These chemical patches have a limited temperature range, last for a maximum of eight hours and most of them are non-reusable. Therefore, the overall cost of using such patches is not ultimately modest. An alternative treatment option is laser heating; but this application draws significant amount of power and often cannot be used in locations that are curvilinear and smaller and/or angular in shape.

To address these issues, the team uses CMOS technology to devise a silicon-based smart thermal patch which is flexible and stretchable. Based on the pain location and spatial requirements, the device can be stretched and contracted back to its original form. The metallic nature of the film allows it to be reusable and have a longer lifespan.

How It Works

Metal has a higher thermal conductivity compared to the traditionally used flexible and stretchable materials such as polymer, fiber and paper.

The KAUST team used low-cost copper, which is used in state-of-the-art CMOS technology for metal interconnects and is fully CMOS-process compatible. To deal with the inherent rigidity of copper, the team has introduced stretchability using a lateral spring design, achieving a record-breaking 800% stretching from copper metallic interconnects. The device has copper-based islands like thermal heaters and sensors with a communication and controller IC and a coin-sized battery.

This work with unprecedented stretchability in naturally rigid copper interconnects opens up exciting opportunities in the emerging field of flexible and stretchable electronics and lays down the foundation of smart, web-integrated electronic systems with life in them.

Why It Is Better

This technology improves the use of smart thermal patches in medical devices. Current commercially available thermotherapies include either expensive laser heating or chemical-based pain relief patches that come in different sizes based on the pain locations. These are non-reusable, not suitable for children, effective for short periods of time, have limited heating range and could potentially cause side effects like skin irritation and allergy. In the impoverished parts of the world, both of these options are expensive and mostly unavailable. As an effective alternative, this wirelessly controllable heater is a great solution for thermotherapy.

IP Protection

KAUST has a patent pending for this technology.