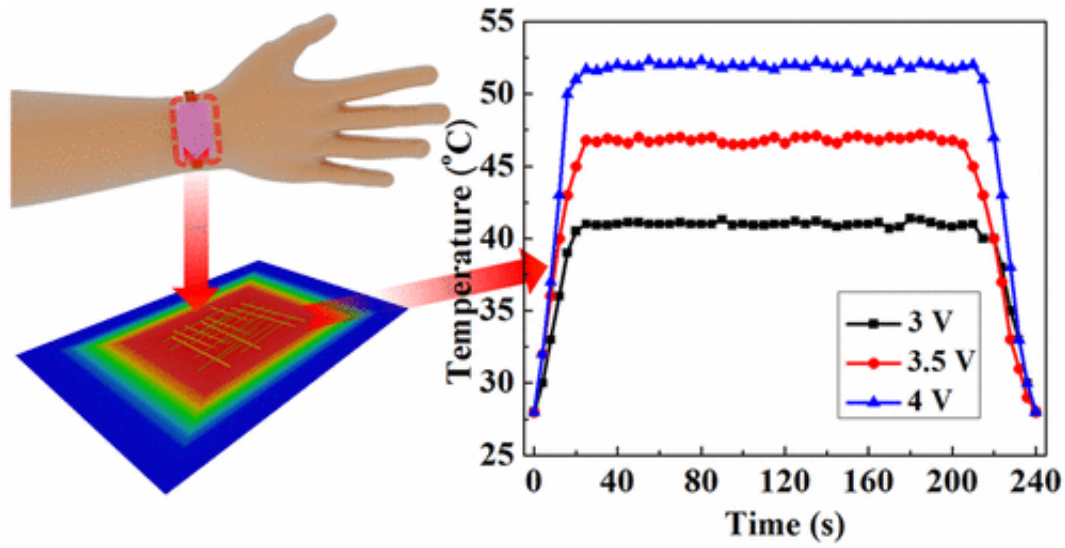
See-through heating pad could help prevent burns from thermotherapy

February 22 2017



Credit: American Chemical Society

To soothe aches and pains, many people turn to heating pads, patches or creams. Although a common practice, thermotherapy can cause burns. Now researchers are developing a transparent heating pad that allows users to see through it to monitor their skin's color and prevent such injuries. They report their approach in the journal *ACS Applied Materials & Interfaces*.

Thermotherapy pads help treat a range of conditions including rheumatoid arthritis. But they've been known to cause burns, particularly

among people who fall asleep with their heating pads on or among the elderly or others who might not be very sensitive to heat. Part of the problem is that commercial heating pads are opaque, and users can't see how their skin is reacting to the therapy. Other researchers have developed transparent alternatives, but they were ultimately too stiff, costly or brittle. Wei Lan and colleagues wanted to address this problem by developing a flexible, see-through device.

To make their thermotherapy pad, the researchers embedded conductive silver nanowires in a thin polyvinyl alcohol film. They then enveloped the film and a copper electrode in biocompatible polydimethylsiloxane, a type of silicone, to insulate the heating element and protect a user's skin. Testing showed that the transparent device heated quickly when 3 volts were applied, which is the typical voltage of coin-cell batteries used in watches, remotes and other small electronics. It was also very flexible and worked well even after being bent 10,000 times.

More information: Wei Lan et al. Ultraflexible Transparent Film Heater Made of Ag Nanowire/PVA Composite for Rapid-Response Thermotherapy Pads, *ACS Applied Materials & Interfaces* (2017). DOI: 10.1021/acsami.6b16853

Abstract
Ultraflexible transparent film heaters have been fabricated by embedding conductive silver (Ag) nanowires into a thin poly(vinyl alcohol) film (AgNW/PVA). A cold-pressing method was used to rationally adjust the sheet resistance of the composite films and thus the heating powers of the AgNW/PVA film heaters at certain biases. The film heaters have a favorable optical transmittance (93.1% at 26 Ω/sq) and an outstanding mechanical flexibility (no visible change in sheet resistance after 10 000 bending cycles and at a radius of curvature ≤1 mm). The film heaters have an environmental endurance, and there is no

significant performance degradation after being kept at high temperature (80 °C) and high humidity (45 °C, 80% humidity) for half a year. The efficient Joule heating can increase the temperature of the film heaters (20 Ω/sq) to 74 °C in ~20 s at a bias of 5 V. The fast-heating characteristics at low voltages (a few volts) associated with its transparent and flexibility properties make the poly(dimethylsiloxane)/AgNW/PVA composite film a potential candidate in medical thermotherapy pads.

Provided by American Chemical Society