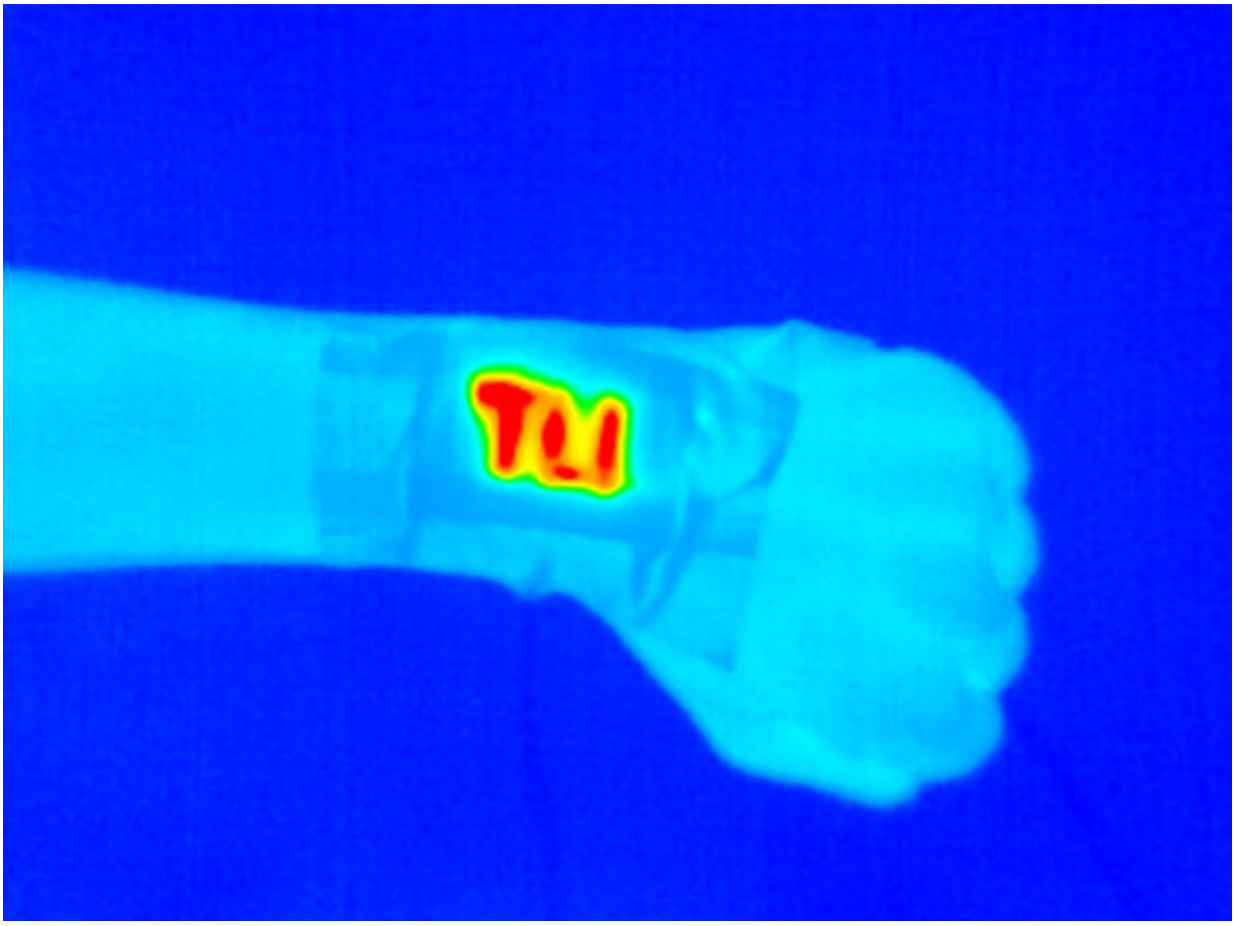
Lightweight electric wristband heaters for constant, portable warmth

October 20 2021



An electrically conductive and durable yarn was sewn onto fabric and became a wearable heater (high temperatures indicated by yellows and reds) when a safe voltage was applied. Credit: American Chemical Society

As the fall chill settles in across the U.S., people are getting out their cozy sweaters and electric blankets, or stocking up on handheld heat packets for extra warmth. But sweaters and blankets are bulky, and heat packs only work for a little while. Now, researchers reporting in *ACS Applied Materials & Interfaces* demonstrate a conductive, durable yarn for lightweight wearable heaters that are re-usable and provide constant, portable warmth.

Lightweight wearable heaters with heating elements embedded within the fabric could help keep people warm, but previous attempts have resulted in hot stiff wires or threads that cannot be safely washed. Recently, researchers have treated fabric and yarn with poly(3,4-ethylenedioxythiophene) and poly(4-styrenesulfonate). This flexible coating warmed up the materials and stayed in place after washing. However, the polymers were not conductive enough for personal heating, and some compounds added to make them more conductive could irritate the skin. So, Rawat Jaisutti and colleagues wanted to improve upon the two-polymer coating applied to yarn so that it could distribute heat at a safe operating voltage when sewn into fabric.

As a first step, the researchers dipped the polymer-coated cotton yarn into ethylene glycol, which is not irritating to human skin. When they applied voltage to the material, it warmed up, requiring lower voltages to reach high temperatures than some previously reported flexible heaters. Then the team washed treated yarn either repeatedly with water or once with detergent. They found that although in both instances there was a slight loss of conductivity, this loss was significantly less than a version without the ethylene glycol. Finally, the researchers sewed multiple pieces of the yarn into a "TU" pattern on a bit of fabric with an additional fabric backing. When the heater was connected to a three-volt power supply and attached to a person's wrist, the heat distribution in the thermal wristband was steady as it was bent back and forth. The researchers say the wristband can also be powered by a battery via an

external circuit for more portability.

More information: Kuntima Pattanarat et al, Wash-Durable Conductive Yarn with Ethylene Glycol-Treated PEDOT:PSS for Wearable Electric Heaters, *ACS Applied Materials & Interfaces* (2021). DOI: 10.1021/acsami.1c13329