FLEXIBLE ELECTRONICS

Tellurium brings down the temperature*Nat. Nanotechnol.* **15**, 53–58 (2020)

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Flexible electronics typically uses polymer-based substrates whose thermal constraints require the use of semiconducting materials that can be deposited at low temperatures. To be able to develop high-performance circuits, complementary logic is also needed, requiring electron-transporting (n-type) and hole-transporting (p-type) semiconductors with similarly matched performance. Whilst several suitable n-type semiconductors have been developed, such as indium gallium zinc oxide, equivalent p-type semiconductors remain in short supply. Ali Javey and colleagues have now demonstrated a low-temperature-processable p-type semiconducting material ideal for flexible-electronics applications.

The researchers — who are based at the University of California, Berkeley and Lawrence Berkeley National Laboratory —

deposited tellurium by thermal evaporation at substrate temperatures as low as -80°C to fabricate the semiconducting thin films. Notably, lower substrate temperatures led to larger domain sizes, which, in turn, improved charge transport properties. Transistors were fabricated on a range of flexible and rigid substrates, with flexible devices exhibiting effective mobilities of around $30\text{ cm}^2\text{ V}^{-1}\text{ s}^{-1}$ and on/off ratios of 10^3 , as well as stable performance under bending up to a radius of 4 mm. Javey and colleagues were also able to fabricate several unipolar logic circuits, including a full adder and a two-bit multiplier.

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Published online: 24 January 2020

<https://doi.org/10.1038/s41928-020-0369-0>