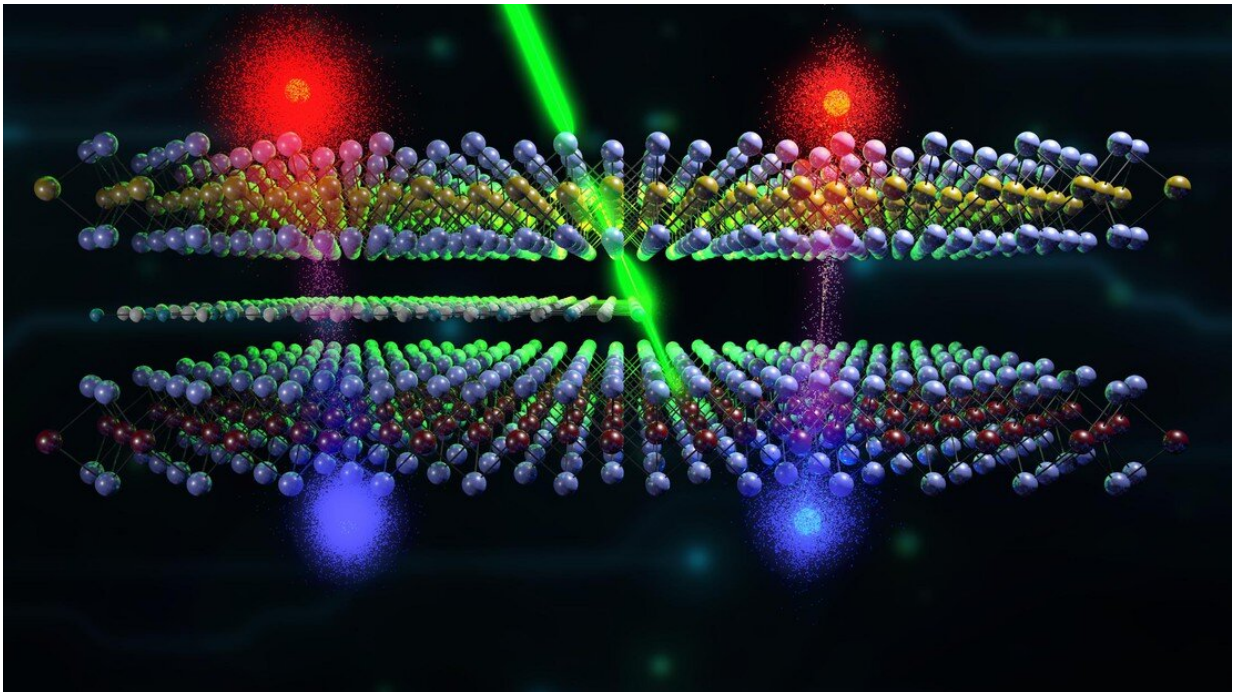


Excitons will shape the future of electronic devices

October 23 2019, by Sarah Perrin



Credit: EPFL

Excitons are quasiparticles made from the excited state of electrons and—according to research being carried out EPFL—have the potential to boost the energy efficiency of our everyday devices.

It's a whole new way of thinking about electronics. Excitons—or quasiparticles formed when electrons absorb light—stand to

revolutionize the building blocks of circuits. Scientists at EPFL have been studying their extraordinary properties in order to design more energy-efficient electronic systems, and have now found a way to better control excitons moving in semiconductors. Their findings appear today in *Nature Nanotechnology*.

Quasiparticles are temporary phenomena resulting from the interaction between two particles within solid matter. Excitons are created when an electron absorbs a photon and moves into a higher energy state, leaving behind a hole in its previous energy state (called a "valence band" in band theory). The electron and electron hole are bound together through attractive forces, and the two together form what is called an exciton. Once the electron falls back into the hole, it emits a photon and the exciton ceases to exist.

Last year, a team of scientists from EPFL's Laboratory of Nanoscale Electronics and Structures (LANES) announced that they had developed a transistor—one of the components of circuits—that runs on excitons rather than electrons (see article). And for the first time, they were able make the transistors function at [room temperature](#), a major step forward for developing practical applications for this technology.

To make the excitons last longer, the scientists layered two different 2-D materials on top of each other: tungsten diselenide (WSe_2) and molybdenum diselenide (MoSe_2). The resulting material had a shimmering texture that influenced how the quasiparticles were distributed. "With these two materials, the excitons tended to group together in specific places and prevent the current from flowing," says Andras Kis, the head of LANES and a coauthor of the study. To prevent that from happening, this time the research team added a middle layer of hexagonal form boron nitride (h-BN), which let them see the excitons and their energy levels more clearly.

The research team also discovered a way to polarize the [exciton](#) currents, meaning the quasiparticles could eventually be used to encode data independently through variations in current magnitude as well as its polarization. That opens the door to even more applications in both coding and data processing on a nanoscopic level.

More information: Dmitrii Unuchek et al. Valley-polarized exciton currents in a van der Waals heterostructure, *Nature Nanotechnology* (2019). [DOI: 10.1038/s41565-019-0559-y](https://doi.org/10.1038/s41565-019-0559-y)

Provided by Ecole Polytechnique Federale de Lausanne

Citation: Excitons will shape the future of electronic devices (2019, October 23) retrieved 19 April 2024 from <https://phys.org/news/2019-10-excitons-future-electronic-devices.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--