Researchers discover new two-dimensional semiconductor

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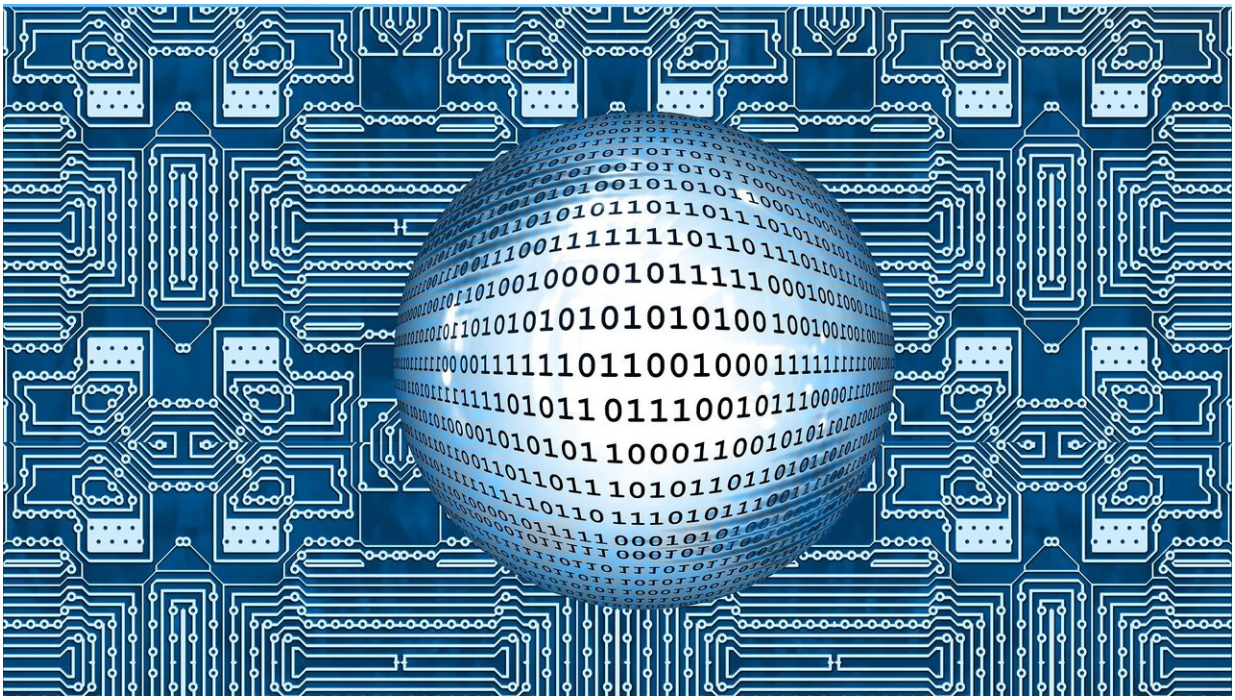

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Researchers of Valencia Unviersity (UV) have discovered a two-dimensional semiconductor that has its excitons orientated in a novel way, paving the way for the generation of integrated photonic chips.

The second quantic revolution that is taking place today is being led in Europe by the Quantum Flagship programme, which intends to take

quantic processes from the laboratory to the market. In the new two-dimensional materials, such as graphene or two-dimensional semiconductors, quantic phenomena leave their traditional field of low temperatures to appear even at room temperature. This fact, which is very unusual, has contributed towards two-dimensional semiconductors being one of the main focal points of Quantum Flagship to create disruptive technologies that give way to marketable devices that take advantage of the quantic properties of light and matter with, for example, uses in the field of signal encryption and secure communications.

In semiconductors, the particle responsible for the processes of light absorption and emission is the electron-hole known as exciton. Knowing and controlling the properties of excitons in two-dimensional semiconductors is key for the development of quantic technologies that are to be developed in the framework of the Quantum Flagship. To the extent that the distribution of the excitons of a two-dimensional semiconductor by itself can define what type of optoelectronic device can be manufactured to take advantage of the quantic light that the two-dimensional semiconductor can emit.

The excitons of semiconductors studied heretofore have an essentially horizontal orientation, with the benefits and limitations that this entails. However, a research group of the Material Science Institute (ICMUV) and the Department of Applied Physics and Electromagnetism of Valencia University (UV), in collaboration with a group of the Heriot-Watt University of the United Kingdom, have shown that the excitons of the indium selenide (InSe) two-dimensional semiconductor are orientated perpendicularly to the atomic plane, unlike the rest of two-dimensional semiconductors discovered until now.

This new orientation of excitons opens the doors to the creation of flat optoelectronic devices based on two-dimensional materials where the

quantic light emitted horizontally can be sustained and transported with relative ease by way of the layered InSe flakes.

The group of the ICMUV and the Department of Applied Physics, comprised of Daniel Andrés Penares, Rodolfo Enrique Canet Albiach, Marie Krecmarová, Alejandro Molina Sánchez, Juan P. Martínez Pastor and Juan F. Sánchez Royo, is taking part in one of the 20 consortiums chosen for the first phase of the Quantum Flagship. They have done so with their project named S2QUIP "Scalable Two-Dimensional Quantum Integrated Photonics," where they will develop circuits of quantic photonics by integrating two-dimensional semiconductor materials that are compatible with CMOS technology, often used when manufacturing traditional integrated circuits. Developed in this framework, the work could solve many of the bottlenecks described by the work plans of the U.S. and EU for the development of marketable technology for quantic information.

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