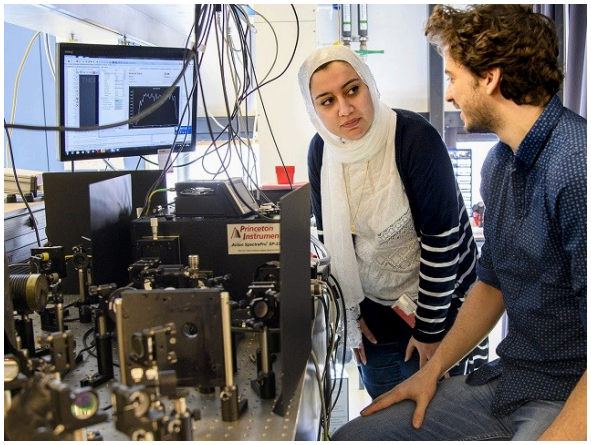
Light-emitting silicon: no longer a “holy grail” for computing

If computers transmitted data using photons instead of electrons, they would perform better and devour less power. European researchers are now studying a new light-emitting alloy of silicon and germanium to obtain photonic chips, which can revolutionise computing.

INDUSTRIAL TECHNOLOGIES

ENERGY



© Alexander Hellemans

Over the last 50 years, photons, the particles that make up light, have replaced electrons to transfer data in communication networks. The very large bandwidth of optical signals has driven the enormous growth of telephone systems, television broadcasting and the internet.

However, photons have not yet replaced electrons in computers. Using light for transmitting data in processor chips and their interconnections would allow a substantial increase in the speed of computers (the speed of on-chip and chip-to-chip communication could be increased by a factor of 1000) and at the same time reduce the power required for them to operate.

Today’s most advanced microprocessor chips can contain tens of billions of transistors, and their copper electrical interconnections produce large amounts of heat when in operation. Unlike photons, electrons have a mass and an electrical charge. When flowing through metals or semiconductor material, they are scattered by the silicon and metal atoms, causing them to vibrate and produce heat. Therefore, most of the power supplied to a microprocessor is wasted.

The challenge of emitting light from silicon

Today the whole electronics industry is geared up to use silicon in computer chips because of the advantageous electronic properties of this material and its availability. It is a good semiconductor, a very abundant element and – as silicon oxide – a constituent of glass and sand.

However, silicon is not very good at dealing with light because of its crystalline structure. For example, it cannot generate photons or control their flux for data processing. Researchers have investigated light-emitting materials, such as gallium arsenide and indium phosphine, but their application in computers remains limited because they don't integrate well with current silicon technology.

Shaping photonics chips: towards a revolution in the electronics industry

Recently, European researchers reported in the journal Nature an innovative alloy of silicon and germanium that is optically active. It is a first step, says Jos Haverkort, a physicist at the Eindhoven University of Technology in the Netherlands: "We showed that this material is very suitable for light emission, and that it is compatible with silicon."

The next step is to develop a silicon-compatible laser that will be integrated into the electronic circuitry and be the light source of the photonics chips. This is the ultimate aim of the project SiLAS, supported by the EU programme FET. The team, led by Erik Bakkers from the Eindhoven University, also includes researchers from the universities of Jena and Munich in Germany, Linz in Austria, Oxford in the UK and from IBM in Switzerland.

To create the laser, the scientists combined silicon and germanium in a hexagonal structure, which is able to emit light, overcoming all known uses of silicon where the atoms are arranged in a pattern of cubes. And it has not been easy. An initial attempt to coax silicon into adopting a hexagonal structure by depositing silicon atoms on a layer of hexagonal germanium failed.

Silicon stubbornly refuses to change its cubic structure when grown on planar hexagonal germanium, explains Jonathan Finley of the Technical University of Munich, and who took part in the research by measuring the optical properties of the created silicon samples. "You have to convince Mother Nature to allow the growth of this unusual form of silicon germanium. It likes to grow cubic, that is what it does," he says.

Read the full article on: http://www.fetfx.eu/story/light-emitting-silicon-no-longer-holy-grail-computing/

Parole chiave

silicon, photons, electrons, germanium, photonic chips, speed of computer, microprocessor chips, light, optically active, silicon-compatible laser

Contributore

Contributo di

iCube Programme
Via Volturno, 15
26900 Lodi
Italy
Sito web

Progetti correlati

SiliconLaser

SiLAS

6 Settembre 2024

PROGETTO

Stimulating effects of Future and Emerging Technologies through communication and outreach

FETFX

6 Settembre 2023

PROGETTO

Ultimo aggiornamento: 15 Maggio 2020

Permalink: https://cordis.europa.eu/article/id/418148-light-emitting-silicon-no-longer-a-holy-grail-for-computing/it