Green light from Silicon

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(PhysOrg.com) -- Researchers at the University of St Andrews have made a surprise discovery that the material at the heart of the microelectronics industry can emit green light.

The development in silicon, a principal constituent of natural stone, glass, concrete and cement, could lead to applications in monitoring the signal quality of internet connections.

The team at St Andrews, which was led by Professor Thomas Krauss from the University's School of Physics & Astronomy, has found that only high quality signals will produce green light that can then be easily detected; weak signals and noise will not.

Professor Krauss explained, "The main significance really is scientific curiosity; silicon strongly absorbs green light, so seeing it emit such light is really quite remarkable.

"Furthermore, the process requires three infrared photons to work together in order in order to create a single green one, which is a very rare event; only by digging deep in our photonic crystal toolkit were we able to satisfy the different conditions required for this to happen."

The green light process will provide a very sensitive method of monitoring power flow in an optical circuit; if the infrared power changes a little, the amount of green light changes a lot, so the green light provides a very sensitive measure of the amount of infrared light present.

In collaboration with a team at Sydney University, the St Andrews physicists have shown that the optical properties of silicon can be extended even further and have demonstrated the creation of green light by a process called 'third harmonic generation'.

Professor Krauss continued, "The process combines three infrared photons into a single green one. It is naturally very weak, especially in silicon, but by concentrating the light strongly in a photonic crystal as well as slowing the light down, the process was enhanced sufficiently to yield sizeable emission.

"Apart from being excited about observing such a fascinating interplay between a number of physical effects, we are now considering possible applications in all-optical signal processing and the ultrafast monitoring of optical signals."

The properties of silicon do not naturally offer themselves for these applications, but with ingenuity, researchers have now demonstrated applications such as optical switching, modulation and optical amplification.

Silicon is now being used by major companies such as Intel and IBM to manufacture circuits that will allow the routing of optical data over the internet.

Provided by University of St Andrews