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NEWS

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Gain in nanowires boosts on-chip photonics

Researchers at Oregon State University tell optics.org about a new method that, in theory, would allow the speed of optical signals in nanoscale wires to be controlled from ultraslow to beyond the speed of light.

A major obstacle for scientists who are trying to exploit the speed of light for on-chip applications is the difficulty of controlling and manipulating light on a nanoscale. In a paper set to be published in Physical Review Letters, theorists at Oregon State University (OSU) have described a way to control the speed of optical signals in nanoscale wires, which could lead to the design of ultra-compact optical photonic devices such as optical transistors and data resynchronizers.

"By incorporating active gain materials into nanoscale waveguides, it is possible to modulate the group velocity and control optical signals in a very versatile way," Viktor Podolskiy, an assistant professor at the OSU's department of physics, told optics.org. "This in particular can be used to construct nanoscale all-optical delay lines, optical data synchronizers, and all-optical buffers with tunable bandwidth."

Podolskiy and Alexander Govyadinov developed a theory which applies to different sub-wavelength waveguide geometries and different sets of waveguide materials, ranging from polar dielectrics to semiconductors, in a spectral region varying from the UV to infrared.

According to the team, even weak light emissions from typical organic dyes -- which cannot compensate for the dispersive qualities of the waveguide -- can be used to control the group velocity of the optical signal from ultraslow to beyond the speed of light.

This development, says the OSU team, offers an insight into an all-optical version of the on-chip semiconductor transistor. "Our work clears the path to the all-optical encoding/decoding/processing of digital information. In the case of an optical transistor, controlling the gain level in turn modulates the propagation velocity of the signal pulse. So when the control pulse is 'on', the signal gets through, and when the control pulse is 'off', the signal stops and gets absorbed or reflected," said Podolskiy.

The researchers are now studying what happens when the gain material is saturated and how quickly the materials respond, with the goal of better understanding how suitable the technique is for ultrafast nanoscale photonics applications.

About the author

Darius Nikbin is a freelance science writer based in the UK.