Nanotechnology Discovery to Make Internet 1000 Times Faster

August 12 2004

Canadian researchers have shown that nanotechnology can be used to pave the way to a supercharged Internet based entirely on light. **The discovery could lead to a network 100 times faster than today's.**

In a study published today in Nano Letters, Professor Ted Sargent and colleagues advance the use of one laser beam to direct another with unprecedented control, a featured needed inside future fibre-optic networks. "This finding showcases the power of nanotechnology: to design and create purpose-built custom materials from the molecule up," says Sargent, a professor at U of T's Edward S. Rogers Sr. Department of Electrical and Computer Engineering.

Until now, engineering researchers have been unable to capitalize on theoreticians' predictions of the power of light to control light. The failure of real materials to live up to their theoretical potential has become known as the "Kuzyk quantum gap" in molecular nonlinear optics. "Molecular materials used to switch light signals with light have, until now, been considerably weaker than fundamental physics say they could be," says Sargent. "With this work, the ultimate capacity to process information-bearing signals using light is within our practical grasp."

To breach the Kuzyk quantum gap, Carleton University chemistry professor Wayne Wang and colleague Connie Kuang designed a material that combined nanometre-sized spherical particles known as "buckyballs" (molecules of carbon atoms resembling soccer balls) with a designed class of polymer. The polymer and buckyball combination created a clear, smooth film designed to make light particles pick up each other's patterns.

Sargent and U of T colleague Qiying Chen then studied the optical properties of this new hybrid material. They found that the material was able to process information carried at telecommunications wavelengths – the infrared colours of light used in fibre-optic cables. "Photons – particles of light – interacted unusually strongly with one another across the set of wavelengths used for communications," says Sargent. "Calculations based on these measurements reveal that we came closer than ever to achieving what quantum mechanical physics tells us is possible."

According to Sargent, future fibre-optic communication systems could relay signals around the global network with picosecond (one trillionth of a second) switching times, resulting in an Internet 100 times faster. To do this, they need to avoid unnecessary conversions of signals between optical and electronic form. Says Sargent: "By creating a new hybrid material that can harness a light beam's power, we've demonstrated a new class of materials which meets the engineering needs of future photonic networks."

The paper addresses a limit originally predicted by Washington State University theorist and physicist Professor Mark Kuzyk. Kuzyk was the first to predict the fundamental physical limits on the nonlinear properties of molecular materials in 2000 and says that by approaching the quantum limit, the U of T-Carleton team has succeeded where all other researchers have failed.

"The report on reaching the quantum limit by the Toronto and Carleton team of researchers is a major advance in the science of nonlinear optical materials that will impact directly many important technologies," says Kuzyk. "This intelligent nanoscale approach to engineering nonlinear-optical materials, which is guided by principles of quantum physics, is the birth of a new and significant materials development paradigm in synthetic research."

Source: University of Toronto

Citation: Nanotechnology Discovery to Make Internet 1000 Times Faster (2004, August 12) retrieved 25 April 2024 from
https://phys.org/news/2004-08-nanotechnology-discovery-internet-faster.html