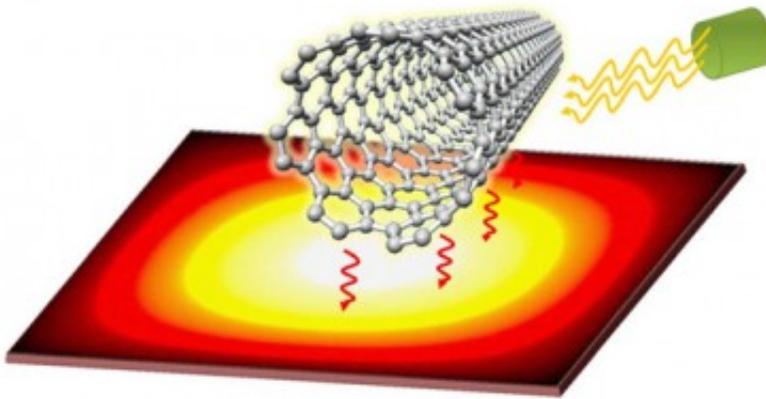


Researchers model world's first carbon-based 'spaser'

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Your T-shirt's ringing: Telecommunications in the spaser age

(Phys.org) —A new version of "spaser" technology being investigated could mean that mobile phones become so small, efficient, and flexible they could be printed on clothing.

A team of researchers from Monash University's Department of Electrical and Computer Systems Engineering (ECSE) has modelled the world's first spaser (surface plasmon amplification by stimulated emission of radiation) to be made completely of carbon.

A spaser is effectively a nanoscale laser or nanolaser. It emits a beam of

light through the vibration of free electrons, rather than the space-consuming electromagnetic wave emission process of a traditional laser.

PhD student and lead researcher Chanaka Rupasinghe said the modelled spaser design using carbon would offer many advantages.

"Other spasers designed to date are made of gold or silver nanoparticles and [semiconductor quantum dots](#) while our device would be comprised of a [graphene](#) resonator and a [carbon nanotube](#) gain element," Chanaka said.

"The use of carbon means our spaser would be more robust and flexible, would operate at [high temperatures](#), and be eco-friendly.

"Because of these properties, there is the possibility that in the future an extremely thin [mobile phone](#) could be printed on clothing."

Spaser-based devices can be used as an alternative to current transistor-based devices such as microprocessors, memory, and displays to overcome current miniaturising and bandwidth limitations.

The researchers chose to develop the spaser using graphene and carbon nanotubes. They are more than a hundred times stronger than steel and can conduct heat and electricity much better than copper. They can also withstand high temperatures.

Their research showed for the first time that graphene and carbon nanotubes can interact and transfer energy to each other through light. These optical interactions are very fast and energy-efficient, and so are suitable for applications such as computer chips.

"Graphene and carbon nanotubes can be used in applications where you need strong, lightweight, conducting, and thermally stable materials due

to their outstanding mechanical, electrical and optical properties. They have been tested as nanoscale antennas, electric conductors and waveguides," Chanaka said.

Chanaka said a spaser generated high-intensity electric fields concentrated into a nanoscale space. These are much stronger than those generated by illuminating metal nanoparticles by a laser in applications such as cancer therapy.

"Scientists have already found ways to guide nanoparticles close to cancer cells. We can move graphene and [carbon](#) nanotubes following those techniques and use the high concentrate fields generated through the spasing phenomena to destroy individual cancer cells without harming the healthy cells in the body," Chanaka said

The paper has been published in *ACS Nano*.

More information: "Spaser Made of Graphene and Carbon Nanotubes. Chanaka Rupasinghe," Ivan D. Rukhlenko, and Malin Premaratne. *ACS Nano* 2014 8 (3), 2431-2438. [DOI: 10.1021/nm406015d](#)

Provided by Monash University

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