Nobel: Big hopes rest on tiny machines

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Molecular machines, which earned their inventors the Nobel Chemistry Prize on Wednesday, are a fraction of the width of a human hair but strong enough to move things 10,000 times their size.

The diminutive devices have yet to find practical use in nanoscale engineering, but scientists look forward to the day when microscopic motors or delivery vehicles will be omnipresent, whether in the human body or a microchip.

Some potential uses:

Medicine

Inspired by natural proteins which act as biological "machines" within cells, synthetic nanobots can be prodded by light or changes in temperature to produce mechanical motion.

Their use for localised drug-delivery is "probably the most short-term achievable" application, according to Nicholas White of the Australian National University's Research School of Chemistry.

The tiny machines, constructed from groups of molecules, may be used to protect the human body from exposure to the toxic effects of certain medicines, such as chemotherapy.

A cancer-killing chemical, for example, could be hidden inside a nanomachine and sent to a specific tumour. Then it would be stimulated

with a light signal to release its potent cargo.

According to Mihail-Dumitru Barboiu, research director at France's CNRS research institute, molecular machines could also be used as valves on implanted drug reservoirs, releasing a pre-programmed dose when prompted, and then closing up again.

Biomimicry

Jacques Maddaluno, a chemistry researcher at the CNRS, imagines a world in which nanobots mimic the function of human cells or even organs.

"We could try to make an artificial cell—molecular machines that do the same thing as living cells," he told AFP.

"We could make artificial copies of biological designs," Maddaluno added.

"These creations could even function outside the body... such as a filter made of artificial cells detoxifying blood" in imitation of the liver.

Some experts expect that nanomachines will find use in prosthetics, perhaps powering artificial or robot limbs.

By their nature, molecular machines already mimic muscle function, expanding or contracting in response to stimulus.

Electronics

The tiny devices may also cause electronics and computer hardware to shrink ever further, experts say.

"We will see memory bits"—the smallest unit of computer storage—"reduced to the molecular level," said Barboiu.

"On the same storage surface where now you have 10 nanoparticles, we will have a hundred molecular machines, which means we will be able to store a lot more" data.

For White, molecular machines may one day replace electronic components such as switches on circuit boards.

"Your components of your electronics could be so much smaller and you could have therefore much more powerful electronics," he said, though cautioning: "we're a long way" from that point.

Nanomachines are still very difficult to construct—taking "several people working for several years" to produce a complex one, said White.

"It's hard to put a timeline, but in the coming years we will see a real application to this being commercialised and put into use."