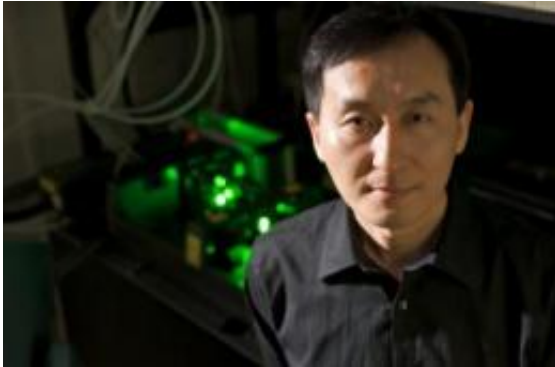


Regular Light Bulbs Made Super-Efficient with Ultra-Fast Laser

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Chunlei Guo stands in front of his femtosecond laser, which can double the efficiency of a regular incandescent light bulb. Credit: University of Rochester

(PhysOrg.com) -- An ultra-powerful laser can turn regular incandescent light bulbs into power-sippers, say optics researchers at the University of Rochester. The process could make a light as bright as a 100-watt bulb consume less electricity than a 60-watt bulb while remaining far cheaper and radiating a more pleasant light than a fluorescent bulb can.

The laser process creates a unique array of nano- and micro-scale structures on the surface of a regular tungsten filament—the tiny wire inside a light bulb—and these structures make the tungsten become far more effective at radiating light.

The findings will be published in an upcoming issue of the journal [Physical Review Letters](#).

"We've been experimenting with the way ultra-fast lasers change metals, and we wondered what would happen if we trained the laser on a filament," says Chunlei Guo, associate professor of optics at the University of Rochester. "We fired the [laser beam](#) right through the glass of the bulb and altered a small area on the filament. When we lit the bulb, we could actually see this one patch was

clearly brighter than the rest of the filament, but there was no change in the bulb's energy usage."

The key to creating the super-filament is an ultra-brief, ultra-intense beam of light called a femtosecond laser pulse. The laser burst lasts only a few quadrillionths of a second. To get a grasp of that kind of speed, consider that a femtosecond is to a second what a second is to about 32 million years. During its brief burst, Guo's laser unleashes as much power as the entire grid of North America onto a spot the size of a needle point. That intense blast forces the surface of the metal to form nanostructures and microstructures that dramatically alter how efficiently can radiate from the filament.

In 2006, Guo and his assistant, Anatoliy Vorobeyv, used a similar laser process to turn any metal pitch black. The surface structures created on the metal were incredibly effective at capturing incoming radiation, such as light.

"There is a very interesting 'take more, give more' law in nature governing the amount of light going in and coming out of a material," says Guo. Since the black metal was extremely good at absorbing light, he and Vorobeyv set out to study the reverse process—that the blackened filament would radiate light more effectively as well.

"We knew it should work in theory," says Guo, "but we were still surprised when we turned up the power on this bulb and saw just how much brighter the processed spot was."

In addition to increasing the brightness of a bulb, Guo's process can be used to tune the color of the light as well. In 2008, his team used a similar process to change the color of nearly any metal to blue, golden, and gray, in addition to the black he'd already accomplished. Guo and Vorobeyv used that knowledge of how to control the size and shape of the nanostructures—and thus what colors

of light those structures absorb and radiate—to change the amount of each wavelength of light the tungsten filament radiates. Though Guo cannot yet make a simple bulb shine pure blue, for instance, he can change the overall radiated spectrum so that the tungsten, which normally radiates a yellowish light, could radiate a more purely white light.

Guo's team has even been able to make a filament radiate partially polarized light, which until now has been impossible to do without special filters that reduce the bulb's efficiency. By creating nanostructures in tight, parallel rows, some light that emits from the filament becomes polarized.

The team is now working to discover what other aspects of a common light bulb they might be able to control. Fortunately, despite the incredible intensity involved, the femtosecond laser can be powered by a simple wall outlet, meaning that when the process is refined, implementing it to augment regular light bulbs should be relatively simple.

Guo is also announcing this month in *Applied Physics Letters* a technique using a similar femtosecond [laser](#) process to make a piece of metal automatically move liquid around its surface, even lifting a liquid up against gravity.

Source: University of Rochester ([news](#) : [web](#))

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