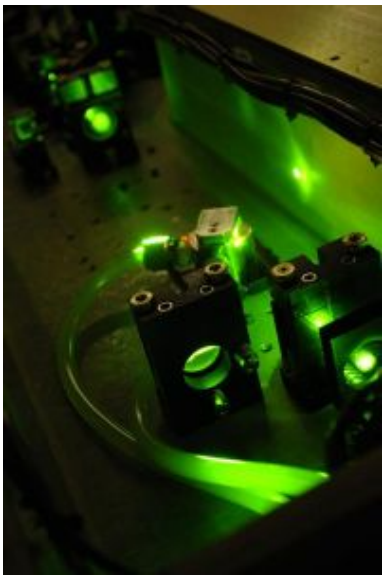
Ultra-fast, ultra-intense laser has clean-cut advantage



The ultra-fast, ultra-intense laser, or UUL, with laser pulse durations of one quadrillionth of a second, otherwise known as one femtosecond, could change cancer treatments, dentistry procedures, precision metal cutting, and joint implant surgeries. Credit: Photo courtesy of University of Missouri, College of Engineering

Many people equate lasers with a sci-fi battle in a galaxy far, far away or, closer to home, with grocery store scanners and compact disc players. However, an ultra-fast, ultra-intense laser, or UUL, with laser pulse durations of one quadrillionth of a second, otherwise known as one femtosecond, could change cancer treatments, dentistry procedures, precision metal cutting, and joint implant surgeries.

“The femtosecond laser has now entered the era of applications. It used to be a novelty, a fantasy,” said University of Missouri researcher Robert Tzou, the James C. Dowell professor and chairman of the department of Mechanical and Aerospace Engineering. “We are currently targeting the areas of life-science and bio-medicine.”

What makes the femtosecond laser different from other lasers is its unique capacity to interact with its target without transferring heat to the area surrounding its mark. The intensity of the power gets the job done while the speed ensures heat does not spread. Results are clean cuts, strong welds and precision destruction of very small targets, such as cancer cells, with no injury to surrounding materials. Tzou hopes that the laser would essentially eliminate the need for harmful chemical therapy used in cancer treatments.

“If we have a way to use the lasers to kill cancer cells without even touching the surrounding healthy cells, that is a tremendous benefit to the patient,” Tzou said. “Basically, the patient leaves the clinic immediately after treatment with no side effects or damage. The high precision and high efficiency of the UUL allows for immediate results.”

Practical applications of this type of laser also include, but aren’t limited to, the ability to create super-clean channels in a silicon chip. That process can allow doctors to analyze blood one cell at a time as cells flow through the channel. The laser can be used in surgery to make more precise incisions that heal faster and cause less collateral tissue damage. In dentistry, the laser can treat tooth decay without harming the rest of the tooth structure.

Associate Professor Yuwen Zhang and Professor Jinn-Kuen Chen recently received a grant from the National Science Foundation to use the laser to “sinter” metal powders—turn them into a solid, yet porous,

mass using heat but without massive liquefaction—a process which can help improve the bond between joint implants and bone.

“With the laser, we can melt a very thin strip around titanium micro- and nanoparticles and ultimately control the porosity of the bridge connecting the bone and the alloy,” Zhang said. “The procedure allows the particles to bond strongly, conforming to the two different surfaces.”

Tzou said the installation of a new laser laboratory at MU will enable research teams to “aggressively pursue success at a national level.” The femtosecond laser lab, components of which were installed in January, was made possible through a gift from engineering alumnus Bill Thompson and his wife Nancy. Tzou noted that the arrival of the lab at MU has initiated additional funding requests that will utilize the new femtosecond laser in research. Zhang, Chen and engineering professor Frank Feng also were the recipients of a United States Department of Defense grant to research possible military applications of the UUL.

Tzou said most research with femtosecond lasers, thus far, has focused on engineering materials such as metals and semiconductors. Because of the unique infrastructure at MU, where the college of engineering and the medical school are located on the same campus, Tzou has been able to attract faculty members who have renowned expertise in medicine and laser technology to collaborate.

Source: University of Missouri-Columbia

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