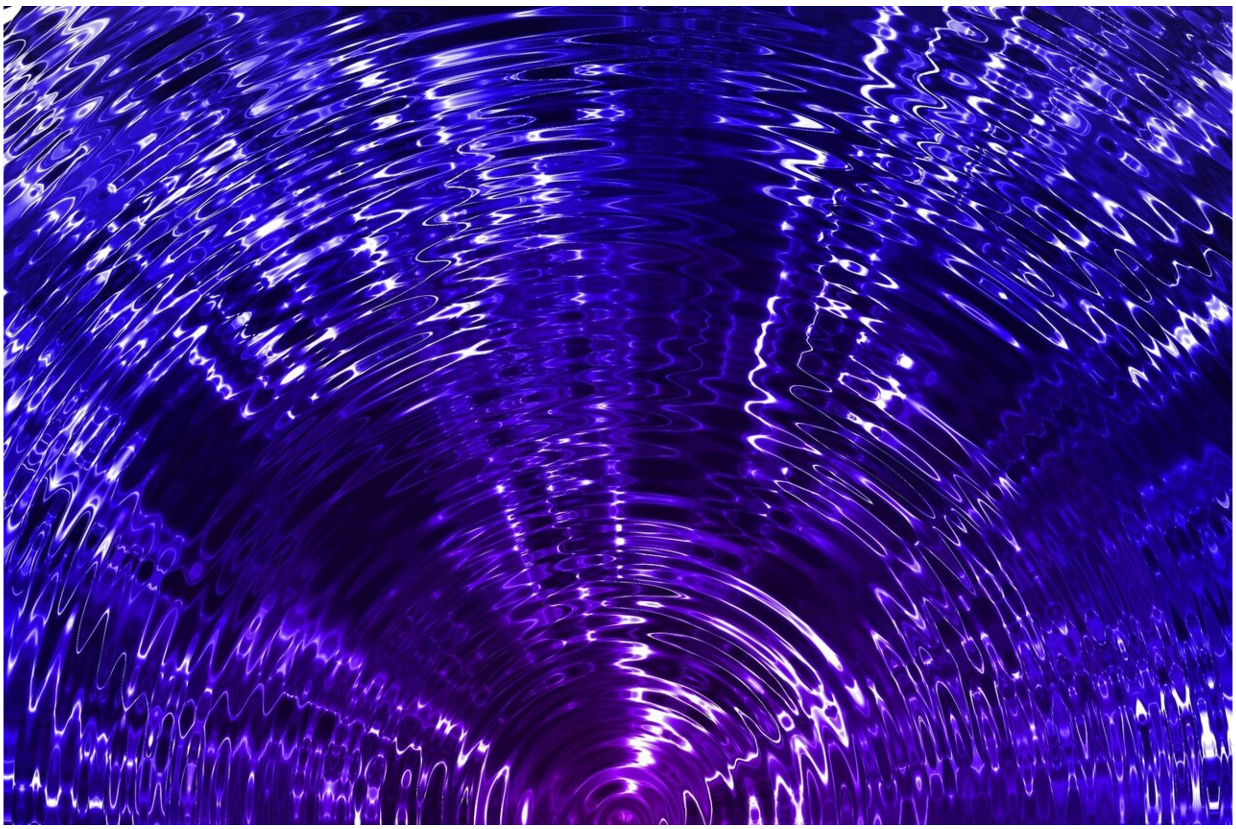
Terahertz radiation can disrupt proteins in living cells

June 2 2020



Credit: CC0 Public Domain

Researchers from the RIKEN Center for Advanced Photonics and collaborators have discovered that terahertz radiation, contradicting conventional belief, can disrupt proteins in living cells without killing them.

This finding implies that terahertz radiation, which was long considered impractical to use, may have applications in manipulating cell functions for the treatment of cancer, for example, but also that there may be safety issues to consider. Terahertz radiation is a portion of the electromagnetic spectrum between microwaves and infrared light, which is often known as the "terahertz gap" because of the current lack of technology to manipulate it efficiently. Because terahertz radiation is stopped by liquids and is non-ionizing—meaning that it does not damage DNA in the way that X-rays do—work is ongoing to put it to use in areas such as airport baggage inspections. It has generally been considered to be safe for use in tissues. However, some recent studies have found that it may have some direct effect on DNA, though it has little ability to actually penetrate into tissues, meaning that this effect would only be on surface skin cells.

One issue that has remained unexplored, however, is whether terahertz radiation can affect biological tissues even after it has been stopped, through the propagation of energy waves into the tissue. The research group from RAP recently discovered that the energy from the light could enter into water as a shockwave. Considering this, the group decided to investigate whether terahertz light could also have an effect like this on tissue.

They chose to investigate using a protein called actin, which is a key element that provides structure to living cells. It can exist in two conformations known as (G)-actin and (F)-actin, which have different structures and functions. The (F)-actin is a long filament made up of polymer chains of proteins. Using fluorescence microscopy, they looked at the effect of terahertz radiation on the growth of chains in an aqueous solution of actin, and found that it led to a decrease in filaments. In other words, the terahertz light was somehow preventing the (G)-actin from forming chains and becoming (F)-actin. They considered the possibility that it was caused by a rise in temperature, but found that the small rise, of around 1.4 degrees Celsius, was not sufficient to explain the change. The researchers concluded that it was most likely caused by a shockwave. To further test the hypothesis, they performed experiments in living cells, and found that in the cells, as in the solution, the formation of actin filaments was disrupted. However, there was no sign that the radiation caused cells to die.

Shota Yamazaki, the first author of the study published in *Scientific Reports*, says, "It was quite interesting for us to see that terahertz radiation can have an effect on proteins inside cells without killing them cells themselves. We will be interested in looking for potential applications in cancer and other diseases."

Chiko Otani, the leader of the research groups, says, "Terahertz radiation is coming into a variety of applications today, and it is important to come to a full understanding of its effect on biological tissues, both to gauge any risks and to look for potential applications."

More information: Shota Yamazaki et al. Propagation of THz irradiation energy through aqueous layers: Demolition of actin filaments in living cells, *Scientific Reports* (2020). DOI: 10.1038/s41598-020-65955-5

Provided by RIKEN

Citation: Terahertz radiation can disrupt proteins in living cells (2020, June 2) retrieved 19 April 2024 from https://phys.org/news/2020-06-terahertz-disrupt-proteins-cells.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.