Terahertz radiation

Terahertz (THz) radiation, also known as submillimeter radiation, is a type of electromagnetic radiation that falls between the microwave and infrared regions of the electromagnetic spectrum, with frequencies ranging from 0.1 to 10 terahertz (THz) and wavelengths from 30 micrometers to 3 millimeters.

THz radiation has unique properties that make it suitable for a wide range of applications. For example, THz radiation can penetrate materials that are opaque to visible light, such as paper, clothing, and plastics, while being absorbed by water and some other materials. This makes it useful for imaging and spectroscopy applications in fields such as medicine, biology, and security.

THz radiation is also being explored for use in high-speed wireless communication systems, as it has the potential to offer much higher bandwidths than traditional wireless systems. Additionally, THz radiation can be used for industrial applications such as quality control in manufacturing, as it can detect defects in materials that are invisible to the naked eye.

Despite the potential benefits of THz radiation, there are also concerns about its potential health effects. While THz radiation is non-ionizing and considered safe for human exposure, more research is needed to fully understand its effects on biological tissues and cells.

Terahertz (THz) radiation can affect the degree of DNA methylation, the spectral characteristics of which exist in the terahertz region. DNA methylation is an epigenetic modification in which a methyl (CH3) group is attached to cytosine, a nucleobase in human DNA. Appropriately controlled DNA methylation leads to proper regulation of gene expression. However, abnormal gene expression that departs from controlled genetic transcription through aberrant DNA methylation may occur in cancer or other diseases. In this study, we demonstrate the modification of gene expression in cells by THz demethylation using resonant THz radiation. Using an enzyme-linked immunosorbent assay, we observed changes in the degree of global DNA methylation in the SK-MEL-3 melanoma cell line under irradiation with 1.6-THz radiation with limited spectral bandwidth. Resonant THz radiation demethylated living melanoma cells by 19%, with no significant occurrence of apurinic/apyrimidinic sites, and the demethylation ratio was linearly proportional to the power of THz radiation. THz demethylation downregulates FOS, JUN, and CXCL8 genes, which are involved in cancer and apoptosis pathways. Our results show that THz demethylation has the potential to be a gene expression modifier with promising applications in cancer treatment [1].

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Cheon H, Hur JK, Hwang W, Yang HJ, Son JH. Epigenetic modification of gene expression in cancer cells by terahertz demethylation. Sci Rep. 2023 Mar 26;13(1):4930. doi: 10.1038/s41598-023-31828-w. PMID: 36967404.