Abstracts

Absorption of Millimeter Waves by Human Beings and its Biological Implications

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With recent advances in millimeter-wave technology, including the availability of high-power sources in this band, it has become necessary to understand the biological implications of this energy for human beings. This paper gives the millimeter-wave absorption efficiency for the human body with and without clothing. Ninety to ninety-five percent of the incident energy may be absorbed in the skin with dry clothing, with or without an intervening air gap, acting as an impedance transformer. On account of the submillimeter depths of penetration in the skin, superficial SAR'S as high as 65-357 W/Kg have been calculated for power density of incident radiation corresponding to the ANSI guideline of 5 mW/cm². Because most of the millimeter-wave absorption is in the region of the cutaneous thermal receptors (0.1 - 1.0 mm), the sensations of absorbed energy are likely to be similar to those of IR. For the latter, threshold of heat perception is near 0.67 mW/cm², with power densities on the order of 8.7 mW/cm² likely to cause sensations of "very warm to hot" with a latency of 1.0±0.6s. Calculations are made for thresholds of hearing of pulsed millimeter waves. Pulsed energy densities of 143-579 µJ/cm² are obtained for the frequency band 30-300 GHz. These are 8-28 times larger than the threshold for microwaves below 3 GHz. The paper also points to the need for evaluation of ocular effects of millimeter-wave irradiation because of high SAR's in the cornea.

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