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Fundamental Characteristics of Radiation

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Abstract
Radiation is the emission or transmission of energy as waves or particles through space or through a material medium which is able to penetrate various materials and is often categorized as either ionizing or non-ionizing depending on the energy of the radiated particles. Radiation processing can be defined as exposure of materials with high energy radiation to change their physical, chemical, or biological characteristics, to increase their usefulness, and safety purpose, or to reduce their harmful impact on the environment. Ionizing radiation is produced by radioactive decay, nuclear fission, and fusion, by extremely hot objects, and by particle accelerators. The radiation coming from the sun is due to the nuclear fusion; therefore, we are living in a natural radioactive world. Radioactive substances are common sources of ionized radiation that emit α, β, or γ radiation, consisting of helium nuclei, electrons or positrons, and photons, respectively. Alpha rays are the weakest form of radiation and can be stopped by paper. Beta rays are able to pass through paper but not through aluminum. Gamma rays are the strongest radiation. They are able to pass through paper and aluminum, but not through a thick block of lead or concrete. Alpha and beta radiation are the high energy subatomic particles where gamma radiation is a form of high energy electromagnetic waves. This review presents the fundamental introduction of radiation, the three types of radiation, and their applications.

I. INTRODUCTION:

Radiation, flow of atomic and subatomic particles and of waves, such as those that characterize heat rays, light rays, and X rays. All matter is constantly bombarded with radiation of both types from cosmic and terrestrial sources. This article delineates the properties and behaviour of radiation and the matter with which it interacts and describes how energy is transferred from radiation to its surroundings. Considerable attention is devoted to the consequences of such an energy transfer to living matter, including the normal effects on many life processes (e.g., photosynthesis in plants and vision in animals) and the abnormal or injurious effects that result from the exposure of organisms to unusual types of radiation or to increased amounts of the radiations commonly encountered in nature. The applications of various forms of radiation in medicine and technological fields are touched upon as well.

1. Introduction Radiation is often considered as either ionizing or non-ionizing depending on the energy of the radiated particles. Ionizing radiation emits more than 10 eV to ionize atoms and molecules and break the chemical bonds. This is an important distinction due to the large difference in harmfulness to living organisms. Ionizing radiation is radioactive materials that emit α, β, or γ radiation, consisting of helium nuclei, electrons or positrons, and photons, respectively. Other sources include X-rays from medical radiography examinations of mesons, positrons, neutrons and other particles that constitute the secondary cosmic rays that are produced after primary cosmic rays interact with Earth's atmosphere
2. Radiation is mainly defined as the emission or transmission of energy in the form of waves or particles through space or material medium. Electromagnetic Radiation consists with radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, and gamma radiation (γ), Particle Radiation are found as the form of alpha radiation (α), beta radiation (β), proton radiation and neutron radiation, Acoustic Radiation can be exemplified as ultrasound, sound, and seismic waves and Gravitational Radiation is the radiation that takes the form of gravitational waves, or ripples in the curvature of space time
3. Radiation is the phenomenon of waves radiating which means traveling outward in all direction from a source. This leads to a system of measurements and physical units that are applicable to all types of radiation. Because such radiation expands as it passes through space, and as its energy is conserved (in vacuum), the intensity of all types of radiation from a point source follows an inverse-square law in relation to the distance from its source. Like any ideal law, the inverse-square law approximates measured radiation intensity to the extent that the source approximates a geometric point
4. Radiation with sufficiently high energy can ionize atoms by knocking the electrons off atoms, creating ions. Ionization occurs when an electron is stripped or knocked out from an electron shell of the atom, leaving the atom with a net positive charge. Because living cells and, more importantly, the DNA in those cells can be

damaged by this ionization, exposure to ionizing radiation is considered to increase the risk of cancer. Thus "ionizing radiation" is artificially separated from particle radiation and electromagnetic radiation, simply due to its great potential for biological damage. While an individual cell is made of trillions of atoms, only a small fraction of those will be ionized at low to moderate radiation powers. The probability of ionizing radiation causing cancer is dependent upon the absorbed dose of the radiation, and is a function of the damaging tendency of the type of radiation (equivalent dose) and the sensitivity of the irradiated organism or tissue (effective dose)

5. If the source of the ionizing radiation is a radioactive material or a nuclear process such as fission or fusion, there is particle radiation to consider. Particle radiation is subatomic particle accelerated to relativistic speeds by nuclear reactions. Because of their momenta they are quite capable of knocking out electrons and ionizing materials, but since most have an electrical charge, they don't have the penetrating power of ionizing radiation. The exception is neutron particles; see below. There are several different kinds of these particles, but the majority is alpha particles, beta particles, neutrons, and protons. Roughly speaking, photons and particles with energies above about 10 electron volts (eV) are ionizing (some authorities use 33 eV, the ionization energy for water). Particle radiation from radioactive material or cosmic rays almost invariably carries enough energy to be ionizing

6. Most ionizing radiation originates from radioactive materials and space (cosmic rays), and as such is naturally present in the environment, since most rocks and soil have small concentrations of radioactive materials. Since this radiation is invisible and not directly detectable by human senses, instruments such as Geiger counters are usually required to detect its presence. In some cases, it may lead to secondary emission of visible light upon its interaction with matter, as in the case of Cherenkov radiation and radio-luminescence

7. In this review article we tried to give a general view and idea of three basic radiation processes, Alpha, Beta and Gamma radiations and their applications. Some of the major and recent scientific experiments are discussed to give an opinion and view for the wings of future and further studies.

Radiation is the emission or transmission of energy as waves or particles through space or through a material medium which is able to penetrate various materials and is often categorized as either ionizing or non-ionizing depending on the energy of the radiated particles.

Applications of radiation

Medical applications

The uses of radiation in diagnosis and treatment have multiplied so rapidly in recent years that one or another form of radiation is now indispensable in virtually every branch of medicine. The many forms of radiation that are used include electromagnetic waves of widely differing wavelengths (*e.g.,* radio waves, visible light, ultraviolet radiation, X rays, and gamma rays), as well as particulate radiations of various types (*e.g.,* electrons, fast neutrons, protons, alpha particles, and pi-mesons).

Imaging techniques

Advances in techniques for obtaining images of the body's interior have greatly improved medical diagnosis. New imaging methods include various X-ray systems, positron emission tomography, and nuclear magnetic resonance imaging.

X-ray systems

In all such systems, a beam of X radiation is shot through the patient's body, and the rays that pass through are recorded by a detection device. An image is produced by the differential absorption of the X-ray photons by the various structures of the body. For example, the bones absorb more photons than soft tissues; they thus cast the sharpest shadows, with the other body components (organs, muscles, etc.) producing shadows of varying intensity.

The conventional X-ray system produces an image of all structures in the path of the X-ray beam, so that a radiograph of, say, the lungs shows the ribs located in front and as well as in back. Such extraneous details often make it difficult for the physician examining the X-ray image to identify tumours or other abnormalities on the lungs. This problem has been largely eliminated by computerized tomographic (CT) scanning, which provides a cross-sectional image of the body part being scrutinized. Since its introduction in the 1970s, CT scanning, also called computerized axial tomography (CAT), has come to play a key role in the diagnosis and monitoring of many kinds of diseases and abnormalities.

In CT scanning a narrow beam of X rays is rotated around the patient, who is surrounded by several hundred X-ray photon detectors that measure the strength of the penetrating photons from many different angles. The X-ray data are analyzed, integrated, and reconstructed by a computer to produce images of plane sections through the body onto the screen of a television-like monitor. Computerized tomography enables more precise and rapid visualization and location of anatomic structures than has been possible with ordinary X-ray techniques. In many cases, lesions can be detected without resorting to exploratory surgery.

Positron emission tomography (PET)

This on tracer studies, see radioactivity: Applications of radioactivity. imaging technique permits physicians to determine patterns of blood flow, blood volume, oxygen perfusion, and various other physiological, metabolic, and immunologic parameters. It is used increasingly in diagnosis and research, especially of brain and heart functions.

PET involves the use of chemical compounds "labeled" with short-lived positron-emitting isotopes such as carbon-11 and nitrogen-13, positron cameras consisting of photomultiplier-scintillator detectors, and computerized tomographic reconstruction techniques. After an appropriately labeled compound has been injected into the body, quantitative measurements of its activity are made throughout the sections of the body being scanned by the detectors. As the radioisotope disintegrates, positrons are annihilated by electrons, giving rise to gamma rays that are detected simultaneously by the photomultiplier-scintillator combinations positioned on opposite sides of the patient.

Nuclear magnetic resonance (NMR) imaging

This method, also referred to as magnetic resonance imaging (MRI), involves the beaming of high-frequency radio waves into the patient's body while it is subjected to a strong magnetic field. The nuclei of different atoms in the body absorb radio waves at different frequencies under the influence of the magnetic field. The NMR technique makes use of the fact that hydrogen nuclei (protons) respond to an applied radio frequency by reemitting radio waves of the same frequency. A computer analyzes the emissions from the hydrogen nuclei of water molecules in body tissues and constructs images of anatomic structures based on the concentrations of such nuclei. This use of proton density makes it possible to produce images of tissues that are comparable, and in some cases superior, in resolution and contrast to those obtained with CT scanning. Moreover, since macroscopic movement affects NMR signals, the method can be adapted to measure blood flow. The ability to image atoms of fluorine-19, phosphorus-31, and other elements besides hydrogen permit physicians and researchers to use the technique for various tracer studies as well.

Radiation exposure can cause a range of health effects, from immediate to long-term, depending on the type and dose of radiation:

- Acute effects

At very high doses, radiation can cause immediate health effects such as:

- Nausea and vomiting
- Skin redness
- Hair loss
- Acute radiation syndrome (ARS), also known as radiation sickness
- Local radiation injuries, also known as radiation burns
- Death
- Long-term effects

Exposure to high levels of radiation can also cause long-term health effects such as:

- Cancer
- Cardiovascular disease

The probability of adverse health effects from radiation is proportional to the dose received, but no level of radiation exposure is completely safe. For example, low levels of radiation in the environment don't cause immediate health effects, but they can contribute to your overall cancer risk.

Here are some examples of different types of radiation:

- ultraviolet light from the sun.
- heat from a stove burner.
- visible light from a candle.
- x-rays from an x-ray machine.
- alpha particles emitted from the radioactive decay of uranium.
- sound waves from your stereo.
- microwaves from a microwave oven.

The 5 main types of radiation?

Now, let's look at the different kinds of radiation. There are four major types of radiation:Alpha,Beta,Neutrons & Electromagnetic wavws such as gamma rays ,They differ in mass, energy and how deeply they penetrate people and objects.

II. Conclusion

Radiation existed long before the evolution of life on the earth and isan inevitable part of the environment. Radiation interacts with matter to produce excitation and ionization of an atom or molecule; consequently, physical and biological effects are produced. Compare to the traditional process, the advantage of the radiation process is the absence of any chemical residues. It can be used at all temperatures and can be limited to the surface only. The use of radiation in medicine, industry, agriculture, energy, and other scientific and technological fields has brought tremendous benefits to society as well as the benefits in medicine for diagnosis and treatment in terms of human lives saved are enormous. Radiation is a key tool in the treatment of particular kinds of cancer. The beneficial impacts are almost similar in other fields. There is no human activity or practice that is totally devoid of associated risks. Radiation should be viewed from the perspective that the benefit from it to humankind is less destructive than from many other agents.

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