Adaptation of Radiation Detectors for Sustainable Development

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ABSTRACT

A variety of sophisticated radiation detectors is used in laboratory and field-based experiments related to particle physics, nuclear physics and related branches of science and technology. Many of these experiments are curiosity driven, while some of them have social applications. In this letter, we will discuss some of the prominent gaseous ionization detectors and their possible adaptation towards a sustainable future. Recent experimental and numerical research in the use of environment friendly gas mixtures to be used in such detectors will be covered in some detail. In addition, their application in sustainable and socially relevant technologies will be briefly mentioned.

I. Introduction

Transmission of energy in the form of waves or particles is broadly considered to be radiation. It is a generic term that encompasses gravitational, acoustic and electromagnetic waves, massless neutral particles such as X-rays and □-rays, neutral or charged massive particles, such as neutrons, nuclei, nuclei fragments, electrons, protons, other elementary particles such as neutrinos [**1**]. The passage of radiation may occur through a material medium, or through empty space. Depending on the energy of the particles, a radiation can be ionizing and non-ionizing. In this paper, we will consider only the ionizing radiations. The source of this kind of radiation can be natural, such as the cosmic microwave background, stellar / galactic radiation, natural radioactivity from terrestrial environment. It can also arise out of anthropogenic sources such as mining activities, refinement and preparation of radioactive isotopes, process of nuclear power generation, nuclear explosion etc.

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Detection of radiation is of utmost importance for activities related to the exploration the universe, as well as to categorise constituents of objects in our immediate vicinity. Using radiation detectors, it is possible to explore fundamental constituents of matter and events of astrophysical importance, to evaluate the safety of a nuclear power reactor or a particular living environment, as well as to produce images of various objects of interest for further processing that can have huge impact on topics such as cancer treatment.

Impact of ionizing radiation detectors on science, technology, and society in general, has led to intense activity in the field since late 19th century. At present, there is a wide variety of ionization detectors available, some of the more prominent ones are gaseous detectors, semiconductor detectors, solid-state detectors, scintillators and Cherenkov detectors. Passive detectors such as photography emulsion, radiographic films, nuclear emulsion detectors also are used in appropriate fields [**2**].

Gaseous ionization detectors are among the oldest radiation detectors. They work on the ionizing effect of incoming radiation as a result of its interaction with the gaseous medium. The resulting electrons and ions are made to drift towards different electrodes by the application of suitable electric field. In addition, the fast drfiting electrons participate in further ionizing the gas molecules, giving rise to various ionic states. The