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Evaluation of the W-Value of Various Gases Including ^{3}He and ^{2}H Using Tritium Beta-Ray

In the fiscal year we proceeded only this subject in the tritium laboratory. W-values of various gases have been reported, but the values of each gas depends on the paper. And there is few research report on the accurate measurement of isotopes' w-values. We are developing a new technique aiming at precise determination of W-values of various gases and isotope gases; e.g. ^{3}He, ^{2}H, Ar and Methane. The W-value is mean energy needed to separate a gas molecule into an ion and an electron pair. Then ionization current to be caused by mixed tritium β-ray in each gas is measured by unit liter ionization chamber shown in Fig.1. The volume was large enough to ensure complete absorption of the β-rays of tritium in the mixed gas. When very small amounts of some gas as tritium added to the noble gases, striking increases in the amount of ionization created by a β-particle of given energy are observed. These are called Jesse effect, and increased W-value as a function of concentration for the tritium. A very interesting plot of the Jesse effect in the helium was shown in Fig.2 and 3. We are assessing the Jesse effect in our technique. The experiments were carried out to substitute tritium and emission of β-ray for hydrogen gas and irradiation of ^{60}Co gamma rays. The W-value on the Jesse effect little influenced by the total gas pressure or concentration of the hydrogen. Monte Carlo study of backscattering, and absorption of β-rays from the chamber wall, and of numerical evaluation of the detection efficiency of the system has been made. According to our preliminary experiments and Monte Carlo study, we are establishing a technique to get precise W-values avoiding the wall effect of the ionization chamber.

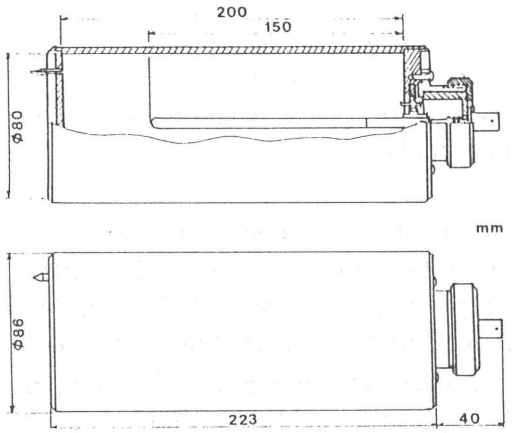

Fig.1 Ionization chamber

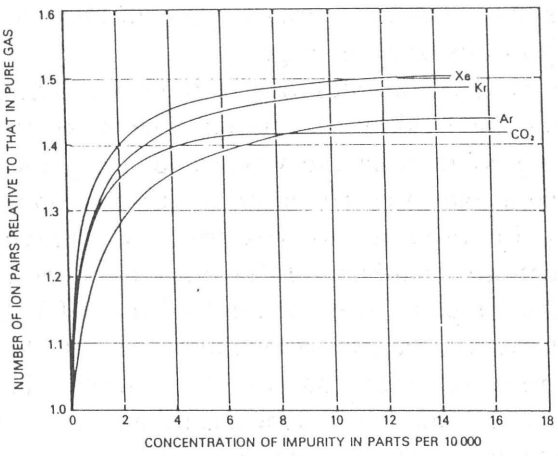

Fig.2 Illustration of Jesse effect in helium. Relative ionization as a function of concentration for various kinds of impurities.

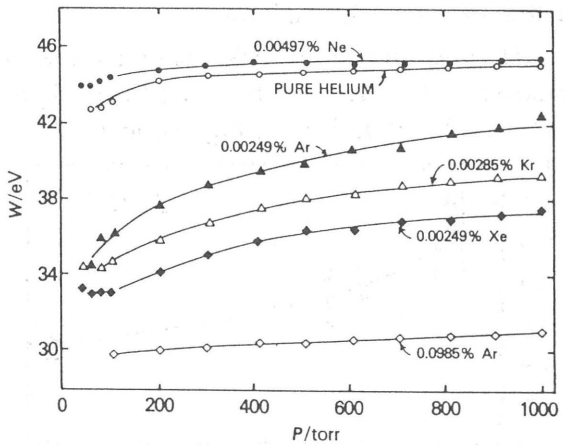

Fig.3 Illustration of the dependence of the Jesse effect in helium on total gas pressure P (1 torr = 133 Pa).