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Effect of Air Luminescence Counts on Determination of ^{222}Rn by Liquid Scintillation Counting*

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本間義夫，村瀬裕子，滝上　誠**

The advantages of liquid scintillation counting for the determination of disintegration rates of ^{222}Rn and the daughters have been demonstrated by a number of investigators. The use of integral counting technique and the fact that ^{222}Rn is appreciably soluble in liquid scintillator make the method particularly useful. However, in the course of a spectral study concerning the relative pulse-height distributions of ^{222}Rn and the daughters in liquid scintillator, we found that, when the counting vial is not full of liquid scintillator, the ^{222}Rn in the space above the liquid scintillator causes air luminescence counts, which has been hitherto neglected by the conventional liquid scintillation counting of ^{222}Rn.

In order to obtain the accurate disintegration rates of ^{222}Rn and the daughters, it is necessary to determine the disintegration rates that are only due to the results of excitation from ^{222}Rn and the daughters dissolved in the liquid scintillator. Since the air luminescence spectra are superimposed upon the beta continuum of ^{214}Pb and ^{214}Bi, the disintegration rates of ^{222}Rn and the daughters dissolved in the scintillator solution were obtained by subtracting the air luminescence spectrum from the corresponding total pulse-height spectrum.

The spectral analysis of the ^{222}Rn sample indicate that ^{222}Rn and the daughters in the gaseous space do produce the air luminescence counts and lead to erroneously high ^{222}Rn activities, unless those air luminescence counts are subtracted from the observed counts. The estimated errors due to the air luminescence are : 12.9% for 8 ml, 6.4% for 12 ml, 2.8% for 16 ml, and 0.3% for 20 ml.

The authors have reached opinion that the most practical method for minimizing the error caused by the air luminescence is to measure ^{222}Rn in the scintillator volume of not less than 20 ml. However, it should be noted that there is a appreciable fall in counting efficiency between 15 to 20 ml of liquid scintillator volume. A detailed investigation concerning the relationship between the volume of scintillator solution and the counting efficiency, which is underway and will be published separately, showed that this fall in counting efficiency could be corrected using integral counting techniques with precision better than 1.2%.

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