TEMPERATURE DEPENDENCE OF PULSE-HEIGHT DISTRIBUTION IN LIQUID SCINTILLATOR

Y. Homma*, Y. Murase, M. Ishii

Kyoritsu College of Pharmacy
1-5-30, Shibakoen, Minato-ku,
Tokyo 105, Japan

Received 18 July 1984
Accepted 8 August 1984

The differential pulse-height distributions for $^{241}$Am, $^{131m}$Xe, $^{14}$C and $^{3}$H are investigated as a function of temperature. The spectra are shifted toward higher pulse-heights with decreasing temperature. During the measurement, the temperature of photomultipliers of liquid scintillation system are kept at 8.8 °C. The counting efficiency of $^{14}$C and $^{3}$H increases with decreasing temperature. The mechanism involved in this effect is discussed.

INTRODUCTION

Several investigations have been reported on the measurement of temperature effect of liquid scintillator. Selieger et al.\textsuperscript{1} reported that the light output of gas-free liquid scintillators increases with decreasing temperature under $\gamma$-ray and $\alpha$-particle excitation. How-

*To whom correspondence should be addressed.
ever, no reasonable interpretation was attempted in that paper. Some authors obtained a similar result and explained their data in terms of the temperature response of photomultiplier, etc. More recently, Kaczmarczyk and Ruge, who used $^{14}$C and $^3$H samples in a study of temperature dependence of counting efficiency in liquid scintillation counting, showed that the counting efficiency of $^{14}$C and $^3$H is improved on sample-cooling and concluded that the effect is contributed to the shift of the balance-point and calibration curve for the external standardization, etc.

Investigations at this laboratory of energy transfer in liquid scintillator were stimulated by these earlier reports and during the course of a spectral study concerning the relative pulse-height distributions from the liquid scintillator, we found that the pulse-height distributions for $^{241}$Am/$\alpha$-particles, 5.49 and 5.44 MeV/, $^{133}$Xe/ internal conversion electrons, 134 and 164 keV/, $^{14}$C and $^3$H in liquid scintillator increase markedly with decreasing temperature, and that the counting efficiency of the $\beta$-emitters also increases with decreasing temperature, although that for $\alpha$-particles and internal conversion electrons remain unchanged. This paper presents more complete data on the temperature dependence of the pulse-height distributions and the counting efficiencies, as well as reasonable explanation for these effects.

**EXPERIMENTAL**

The $^{241}$Am source was dissolved in 1.0N HCl from which it was extracted into 25% v/v solution of di-2-ethylhexyl-phosphoric-acid/HDEHP/ in toluene. Aliquots of this solution were added directly to the scintillator