THE HIGH SENSITIVE RADON MONITOR

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Recently, the measurement of ultra rare nuclear processes, such as double beta decays, dark matter search and so on, have been played an important role in nuclear and particle physics[1]. In order to carry out such measurements, ^{222}Rn in the air is one of the most serious origins of background, as well as natural radioactivities, cosmic rays and neutrons. The radon monitor[2] with an electrostatic concentrator was developed for the measurement of radon emanation rate of the materials used in the detectors for ultra rare nuclear processes.

The radon concentration is derived as $R = \varepsilon Y$, where ε is the detection efficiency and Y is the counting rate of the peak of ^{214}Po. The background for the radon monitor is only radon gas emanated from the cylindrical vessel itself. The radon concentration due to the emanation from vessel is 14.0$\pm$0.889mBq/m^3 for 120days. The sensitivity for the measurement of a radon concentration of a gas in the vessel depends on the radon emanation rate from the vessel. For the present radon monitor, it is 4.3mBq/m^3 for dew point of -40°C and for one day measurement.

The detection efficiency of the peak of the α particle emmited from ^{214}Po depends on the dew point of the measurement gas. The reason is not for a neutralization by the charge exchange between daughter nuclei of radon and H_2O but for the chemical mechanism which is not known [3] because the ionized energy of H_2O(E_I=12.56eV) is higher than daughter nuclei of ^{222}Rn. The efficiency of the radon monitor(Fig.1.) was determined by using of Pylon RNC Calibrated Radon Gas Source (80$\pm$3.2Bq). Before carring out the measurement, inner gas has ventilated by Liquid Nitrogen gas, in order to reduce the radon concentration in vessel. When degassing is complete record the time as T_0. Let the RNC sit for at least 24 hours.While the RNC is building up radon gas. Connect the RNC to the Radon monitor and a pump to from a closed system.We pump to distribute the radon gas throughout the whole system for at least 10 minutes. Disconnect the RNC and the time as T_1. Calculate the radon gas concentration(RC) at T_2 by using the following formula

$$RC = Q(1 - exp(-\lambda t))exp(-\lambda t')/V \quad (1)$$

t=T_1-T_0
t'=T_2-T_1
Q=80Bq($\pm$4%)
λ=0.0001258/min
V=0.07m^3

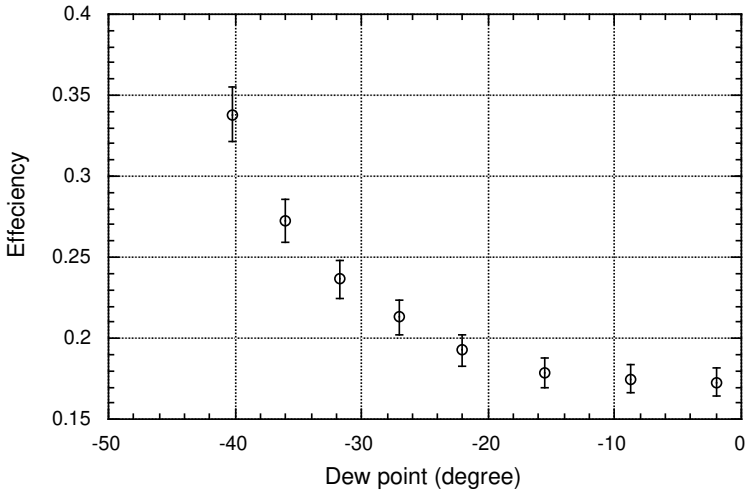

Figure 1: Efficiency of the radon monitor.

References

[1] H.Ejiri etal, Nucl.Instr.Meth. A302 (1991)304

[2] RCNP Annual Report 1997, p.87.

[3] A. Busigin, A. W. van der Vooren, et al., Health Phys. 40(1981)333