Retention of Mn-56 in Neutron-irradiated Potassium Permanganate

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Although the behavior of radioactive manganese atoms produced by (n, γ) reaction on permanganate has been studied by several investigators[1,8,9], no information is available on the effect of irradiation temperature on the retention of radio manganese as permanganate. It has been reported that the retention tends to decrease as the irradiation temperature lowers down to dry-ice or liquid-nitrogen temperature in various inorganic salts such as

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TABLE I. EFFECT OF TEMPERATURE AT BOMBARDMENT SITE

Sample	Length of irradiation, min.	Storage time, min.	Retention, % (Irradiation temperature) −196°C	−72°C	25°C	90~190°C
Crude $KMnO_4$	150	30	—	16.7±0.6	15.2±0.4	—
Recrystallized $KMnO_4$	140	〃	23.8±0.6	23.1±0.4	21.2±0.3 (21.6±0.2)[a]	—
〃	150	〃	23.3±0.5	—	21.8±0.3	38.8±0.4
〃	〃	〃	23.0±0.5	21.0±0.4	20.0±0.3	—
〃	〃	〃	23.5±0.5	23.3±0.4	20.8±0.3 (21.6±0.2)[a]	—

a) Sample was irradiated in a paraffin block (5 cm. thickness). It has been known that the neutron energy has no effect on the retention as $KMnO_4$[8].

TABLE II. EFFECT OF STORAGE TEMPERATURE AFTER BOMBARDMENT

Sample	Length of irradiation, min.	Storage time, min.	Retention, % (Storage temperature) −196°C	−72°C	25°C	85~180°C
Recrystallized $KMnO_4$	60	100	19.3±0.3	—	20.5±0.3	—
〃	90	〃	—	19.2±0.3	19.0±0.3	—
From Aten's data[9]	—	120	—	—	21~26	35~74

$K_3Co(CN)_6$[2], K_2ReCl_6[3], KIO_3[4], K_3AsO_4[5], K_2CrO_4[6] and $[Co(NH_3)_5Br](NO_3)_2$[7].

A seriess of experiments have been carried out by the present author to study the effect of temperature on retention of recoil radio manganese as permanganate. About one-half gram of potassium permanganate in small crystals was placed in separate glass tubes. For low temperature bombardments, the glass tubes were dipped in either liquid nitrogen or dry-ice–etheanol, while they were warmed by preheated oil for high-temperature bombardments. The samples were exposed for two to three hours to neutrons at a flux of ca. 10^7 n/cm^2 sec. The maximum energy of neutrons produced by Be–D reaction was ca. 7 MeV. All bombardments were made in the presence of air. Following the bombardments, the samples were dissolved in distilled water and mixed with a small amount of manganese sulfate solution. The resulting manganese dioxide was filtered through a paper filter without suction. Both the precipitate and the filtrate were reduced with sodium sulfite. The activity of the resulting solution was measured with a dipping type G–M counter, and decay curve was determined. In another series of experiments, the samples were bombarded for 1 to 1.5 hr. at room temperature and then stored for nearly two hours at various temperatures. They were treated in the same way as described above. The results are summarized in Tables I and II.

It is worth mentioning that the bombardment at dry-ice–ethanol or liquid-nitrogen temperature always resulted in slightly higher retentions than the room temperature bombardment did. The results seem to be peculiar as compared with these obtained for other inorganic salts[2-7], in which the retension tends to decrease as the temperature lowers. The bombardment at 90~190°C resulted in highest retentions. This is probably due to an effect similar to thermal annealing. It is seen from Table II that the storage at dry-ice–ethanol or liquid-nitrogen temperature has little effect on the retention.

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