58 Mem. Fac. Educ., Shimane Univ. Vol. 2, pp. 58−60, December, 1968.

STUDIES ON THE NUCLEAR QUADRUPOLE RESONANCE OF IODINE II. EFFECTS OF GAMMA RAY IRRADIATION

By

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1. Introduction

The structure of the nuclear quadrupole resonance line in a single crystal of iodine has been studies [1] and it was found that the line was into five lines at least.

The patterns of the resonance lines in the powder of iodine and in the mixture of iodine and sulfer or paraffin have also been reported [2].

In this paper, the changes of the resonance lines by irradiation with gamma-rays from cobalt-60 was investigated.

After irradiation at an integral does of 1.3×10^5 roentgen, the change of resonance frequency was not found, and the patterns of the resonance lines in the mixtuers were not also changed, but in the single crystal, the resolved lines were vanished and the pattern was changed into the shape of line in the powder. This shows that the structure of a single crystal of iodine was effected some changes by the irradiation of about 10^5 roentgen.

2. Experimental procedures

A block diagram of the apparatus is shown in Fig. 1.

The main part of the apparatus was a super-regenerative oscillator, which was the same as that reported in the previous paper [2]. A frequency modulation apparatus of small amplitude was applied to the oscillator, and the method of narrow band amplifier and phase-sensitive detector was employed.

The frequency of the main oscillator was swept at the rate of 16.5 kc/min by changing capacity with the slow speed synchronous motor of 1 rph. The frequency was measured with the aid of a heterodyne frequency meter.

A single crystal of iodine of 35 gr was prepared by a method of pointed bottom crucible. The mixture of iodine and sulfer or paraffin was made by melting the mixture of pure iodine of 35 gr and sulfer or paraffin of 7 gr respectively. These samples were packed into a vacuum ampoule and located in the rf coil of two turns of the tuned circuit. The derivative curves of resonance lines in the low-frequency side of I^{127} in these samples were recorded and resonance frequencies were measured at room temperature.

These samples were irradiated for 20 minutes at a does rate of 3.9×10^5 R/hr with

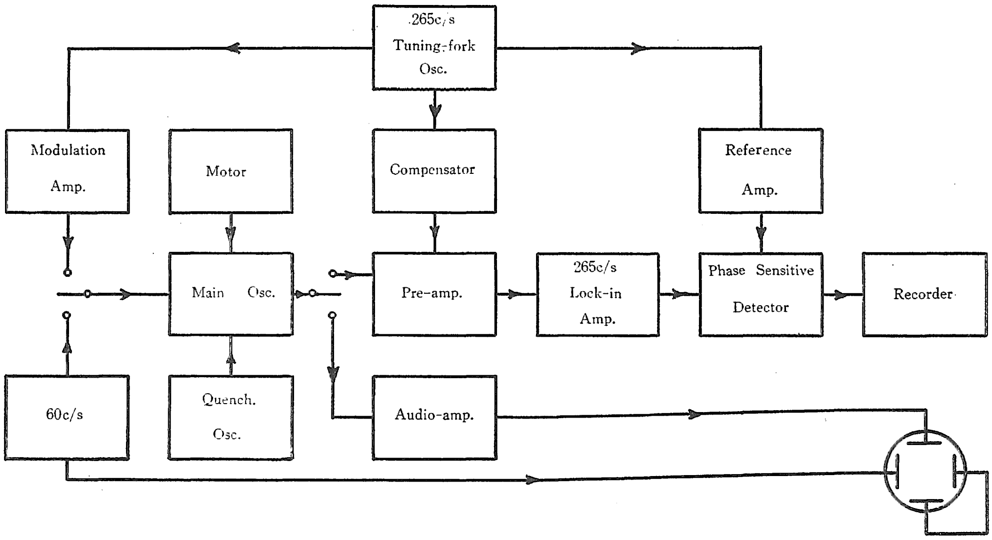


Fig. 1. Block diagram of apparatus.

gamma-rays from cobalt-60 source. After 3 days, the derivative curves of resonance lines were recorded and resonance frequencies were measured.

3. Experimental results

The derivative curve of low-frequency resonance line of I^{127} in the mixture of iodine and paraffin is shown in Fig. 2(a).

In this figure the signals of 331.20 Mc and 331.40 Mc are recorded. The derivative curve of resonance line in the single crystal of iodine is shown in Fig. 2(b). In this figure, the fine structure of nuclear quadrupole resonance line was observed.

The derivative curve obtained from the irradiated mixture of iodine and paraffin is shown in Fig. 2(c). As compared with Fig. 2 (a), difference between the forms of these two lines was not observed.

The derivative curve obtained from the irradiated single crystal is shown in Fig. 2 (d). In this figure, the fine structure of resonance line was faded out by the irradiation.

In Fig. 2, the chart speed of the recorder is 0.2 mm/sec and the frequency increases from the left side to the right side of the figure at the rate of 16.5 kc/min.

The change of resonance frequency by irradiation was not found on all samples, and the frequency was 331.3 Mc at room temperature.

4. Discussion

As the change of the resonance frequency was not found, it may be concluded that the molecular interaction between iodine and sulfer or paraffin in the mixture was not effected by the irradiation.

Disappearance of the fine structure of the resonance line in the single crystale of iodine showes that the crystal was damaged by the irradiation.

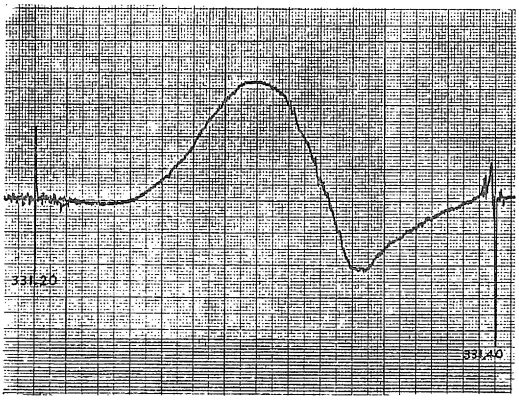


Fig. 2 (a). Derivative curve of resonance line in the mixture of iodine and paraffin.

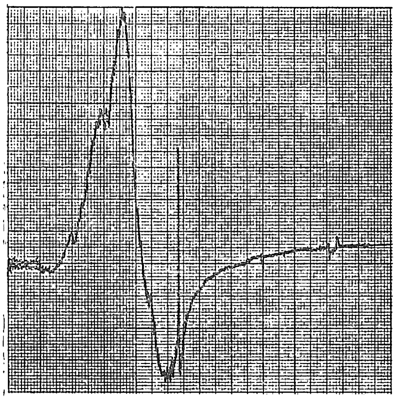
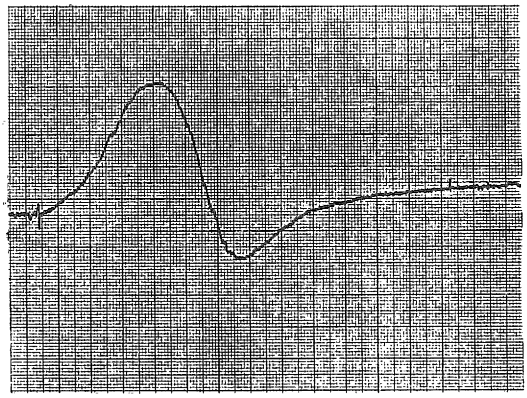


Fig. 2 (b). Derivative curve of resonance line in the single crystal of iodine.



Pig. 2 (c). Derivative curve of resonance line in the irradiated mixture of iodine and paraffin.

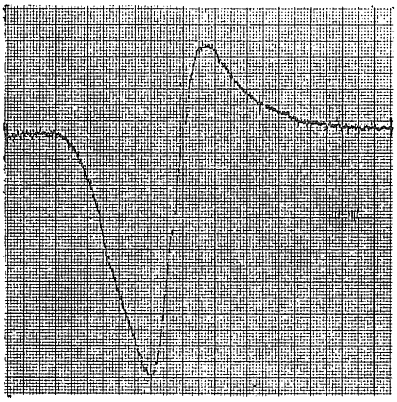


Fig. 2 (d). Derivative curve of resonance line in the irradiated single crystal of iodine.

References

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2) J. Sakami : *Mem. Fac. Educ., Shimane Univ.* **1** (1967) 1.