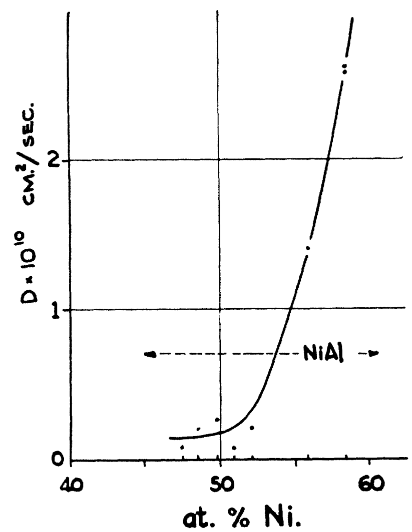

FIG. 2. Diffusion coefficient in NiAl at 1150°C.

increase. The amount of this increase will depend upon the balance between the production and annihilation of $V(A)$.

As illustrated in Fig. 2 experimental results confirm these considerations. Since, at the time the experiments were started, radioactive nickel was not conveniently available, the measurements were made using radioactive cobalt which is known to form a similar compound with aluminum[2] and can substitute for nickel in NiA. Since these alloys are difficult to prepare and on the aluminum-rich side are brittle, a very small quantity of radioactive cobalt was plated on the surface of the sample and the diffusion coefficient computed from the decrease of the activity due to the penetration of cobalt into the samples during 18 hours at 1150°C. The experiment is being repeated with radioactive nickel.

*Research sponsored by ONR.

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Removal of Space-charge in Diamond Crystal Counters

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IT is well known that a steady decrease in the size of the pulses with time is produced in a crystal counter when subjected to ionizing radiations, owing to the setting-up of space-charge inside the crystal. This space-charge is produced by electrons, and possibly positive holes, being held in electron-traps distributed throughout the crystal. Various authors have neutralized the effect of the space-charge by applying an alternating field across the crystal,[1] the supposed explanation being that during the positive half-cycle, the freed electrons are carried from the surface layers into the body of the crystal where they become trapped; and during the negative half-cycle, positive holes migrate into the crystal where some will re-combine with the trapped electrons while others become trapped themselves. The net effect of a continual repetition of this process is, under favorable conditions, to neutralize the space-charge. It has also been suggested[2] that once a space-charge has been set up, the crystal could possibly be returned to its original state by irradiating it with visible light and heat, after which the counting cycle could be repeated. In a theoretical paper by Newton,[3] the depths of most of the traps in diamond are estimated to be between 0.25 and 0.75 electron-volt, corresponding to photon wave-lengths of approximately 5 mμ and 1.6 mμ, respectively. Thus, irradiation of the specimen with a spectrum extending from about 1 mμ to 10 mμ should be sufficient to de-trap most of the electrons. This spectrum is conveniently produced by a Nernst filament.

In this laboratory, experiments have been performed in which light was focused on to the crystal simultaneously with bombardment by alpha-particles from polonium. It was found that with the Nernst light, no photo-conductivity was detected. The temperature of the crystal was that of the room and was kept fairly constant. The field across the crystal was such that, at high intensities of Nernst irradiation, there was a saturation of counting-rate with applied voltage. Only pulses of height greater than twice the noise-level of the amplifier were recorded. The procedure was to allow the counting-rate to decay to zero while the crystal was in the dark and then, to irradiate it with the Nernst illumination. The following change in counting-rate with time was observed, the curve shown being typical of the many obtained.

Portion OA of Fig. 1 shows the decay prior to irradiation. The illumination was begun at A and the counting-rate rose rapidly, being followed by the peculiar "kink" after which, over the part BC, it gradually approached a saturation. At C, the light was removed and the counting-rate was found to decay exponentially and when it had reached its original value, the whole cycle could be repeated. These curves were plotted for various light intensities and as was to be expected, a curve of saturation counting-rate against light intensity itself showed a saturation for the higher intensities, corresponding to conditions in which a high percentage of the incident alpha-particles was being recorded

The use of radiation of suitable wave-lengths to remove space-charge appeared as satisfactory as the method of field reversal, since, when the latter was carried out, the pulse heights were the same as those reached when the higher intensities of light were used.

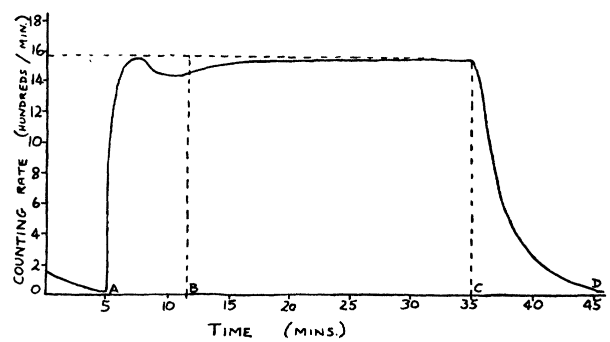

FIG. 1. Variation of counting-rate with time on irradiating the diamond with a Nernst light.

Most of the above experiments were performed on one specimen only, but the behavior of other diamonds differed only in degree.

No simple explanation of the kink in the curve seems forthcoming but it is interesting to note that Newton obtained from theoretical considerations a curve exhibiting the same appearance, though his theory deals with slightly different experimental conditions. It is not clear whether our experiments can be interpreted directly in terms of Newton's curve but this point is being investigated.

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