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Physics General



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# Summary of the Research Progress Meeting

June 24, 1948

R. K. Wakerling



Berkeley, California

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Summary of the Research Progress Meeting

June 24, 1948
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Spectrographic Analysis of Alpha Active Materials. J. Conway.

Spectrographic and spectrochemical analyses of alpha active material are being made in the Laboratory on samples varying in size from 1 to 50 micrograms. Samples of plutonium, americium and curium have been run with good results. One of the principal problems involved is that of health protection since the specific activities involved are extremely high.

As an illustration of the method employed, a 50 microgram sample of plutonium is handled in the following way: The material in solution is placed on the end of a carefully prepared copper electrode. These electrodes are made of 1/4" copper rod, the end of which is milled and carefully kept free of any contamination. The solution is then evaporated under heat lamps until it is completely dry. These operations are carried out in a dry box especially prepared for the process (see Figure 1). At the same time four other electrodes are prepared with standard solutions. These four, together with a plain copper electrode, are used as controls to furnish comparison spectra.

These electrodes are next placed in a spark box, shown in Figures 2 and 3, with and without its cover. The box is partially evacuated and the electrodes sparked. The light from the spark leaves the chamber through a quartz window and passes into a commercial spectrograph. The portion of the spectrum in the region from 3000 to 4500 $A^{o}$ is the one most frequently used in the comparison. The interpretation and analysis of the spectrum is done by purely visual methods. A more accurate analysis could be made by use of a spectrophotometer, but the visual comparison is sufficiently accurate for most purposes. Some sample spectrograms were exhibited.

By the use of this technique very minute quantities of material can be detected and the amounts estimated, together with the amounts of the impurities involved if the sample is large enough. The sensitivity of the method may be judged from the sensitivities for aluminum, silver, beryllium and thorium, which are respectively 1/500, .1, .005 and .1 micrograms.

A difficult problem involved is that of recovering the active material from the spark box after it is vaporized. In the past, two glass wool filters have been used between the pumps and the chamber to filter out the activity. This of course does not take care of the material that is deposited on the interior walls of the chamber. At present the system is being re-designed so that the exhaust port will be very close to the electrodes in the hope that a great amount of the material vaporized will be deposited on a filter located very close to this opening. Since in many cases the active material is extremely rare, it is important that as much of it be recovered for further use as possible. It is believed that it should be possible to recover as much as 98 percent of the material in the original sample.

Range Energy Determinations.

Dr. R. L. Thornton, Mr. Walter Stephan and Mr. Walter Aron discussed the experimental theoretical work being done on the range energy determinations for deuterons from the 184-inch cyclotron. Some time ago preliminary measurements were made on the range of deuterons in several materials using the electrostatically deflected deuteron beam. In these experiments the beam was allowed to impinge upon a wedge-shaped plate of the material being tested which was backed with X-ray film. The particles would then pass through the portions of the wedge that were narrow enough and would be registered on the photographic film, while those striking the thicker portions of the wedge would be unable to pass through and no blackening would appear on the film.

Thus the thickness of the material corresponding to the cut-off edge on the film would give a measure of the range of the particles in that substance. Due to the spread in energy of the particles in the beam and straggling, the cut-off was not very sharply defined, and consequently the method was not one of great sensitivity. These experiments were discontinued until the external deuteron beam became available.

The arrangement used in Figure 4 was devised for use with the external deuteron beam. The beam is collimated and allowed to pass through a thin monitor ionization chamber and then successively through the absorbing material and a thin detector ionization chamber. When the current to the detector chamber is plotted as a function of the thickness of the absorber material for aluminum the characteristic Bragg curve shown in Figure 5 is obtained. For aluminum the range is 2.73" . The drop off in the curve from its maximum to the high end is extremely sharp. By using the curve in this range a very sensitive determination of the stopping power of various materials relative to Al may be obtained. Enough aluminum is used together with the thin sample of material being tested to place the observation in this portion of the curve. By placing the sample of absorbing material at various distances through the aluminum absorber, its stopping power for particles of various energies can be measured rather accurately. Measurements are usually made at energies of 50, 100, 150 and 190 Mev.

One may also get a direct measurement of the change of energy $\frac{dE}{dx}$ upon the basis of assumed energies for aluminum. Values secured in this way compare very well with those computed by the theoretical group. The variation of the quantity

$$S = \frac{(\Delta RZ/A)_{Al}}{(\Delta RZ/A)_{\text{other material}}}$$

with the logarithm of the atomic number is shown in Figure 6. An attempt is now being made to use these experimental data on the range energy relation

to correct the values of the average ionization potentials used in the theoretical calculations to improve the accuracy of these calculations.

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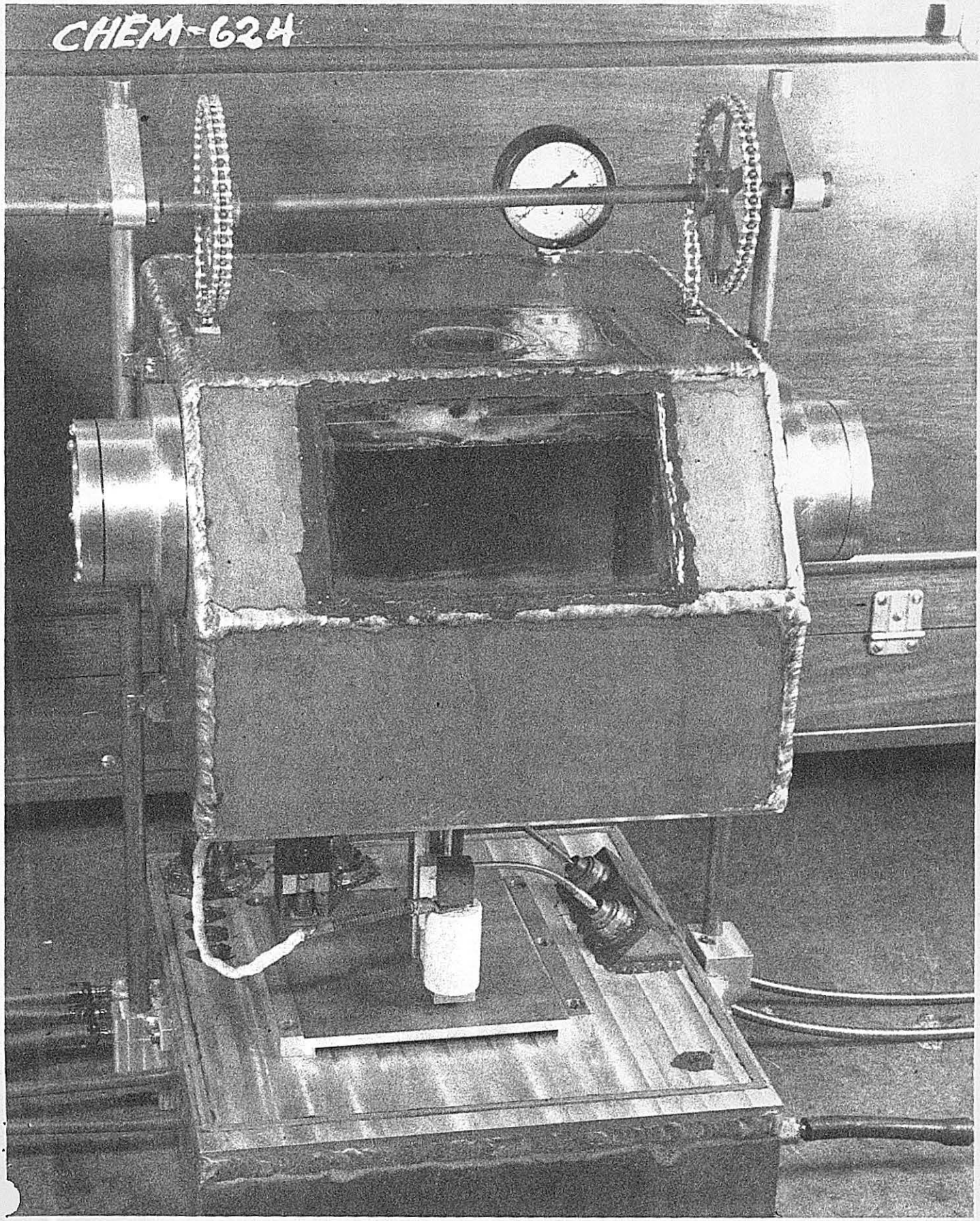
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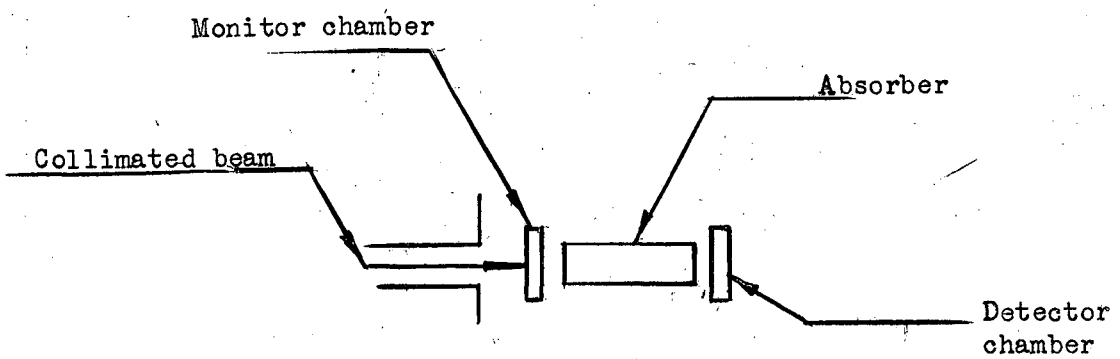


Fig. 4

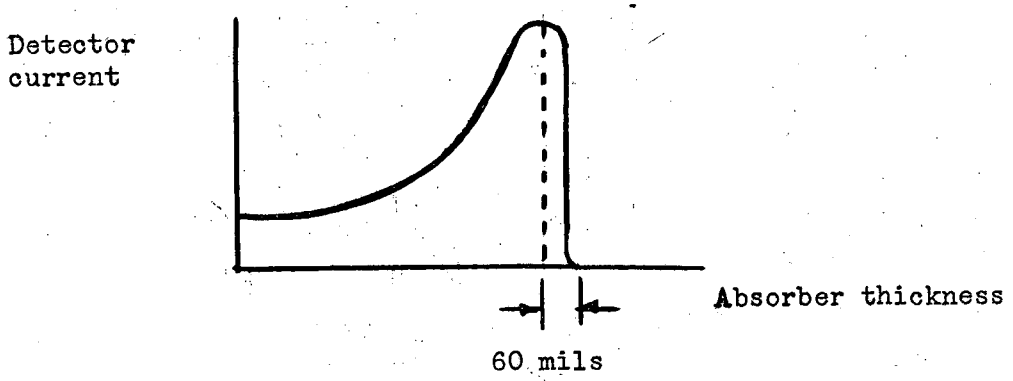


Fig. 5

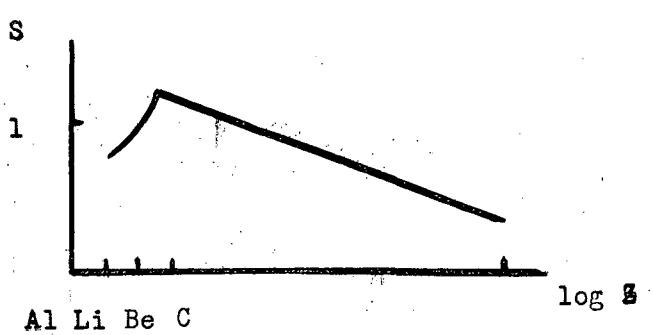


Fig. 6