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PREPARATION OF URANIUM TRICHLORIDE BY REDUCTION OF THE TETRACHLORIDE WITH METALS⁽¹⁾

Written by: H. S. Young

(Authorship does not imply responsibility for the ideas or experimental data reported. For the source material consult the references which appear at the end of the paper.)

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INTRODUCTION

When metallic copper was exposed to vapors of uranium tetrachloride, it was found that uranium trichloride and copper chloride were formed. The formation of uranium trichloride from copper and the tetrachloride suggested that it might be convenient to prepare pure uranium trichloride in a similar fashion, using a metal that would leave no contaminants in the product.

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For the Atomic Energy Commission

Charles A. Feller
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DISCUSSION

Various metals were exposed to pure uranium tetrachloride vapors in a vacuum sublimation apparatus. In each case the overall reaction was found to be:



A difficulty was presented by the fact that with many metals the uranium trichloride formed a hard coat of dark red crystals on the metal surface, preventing further reaction, and was contaminated by the chloride of the metal.

It was thought that a metal which sublimed readily and which had a volatile chloride should be satisfactory. Zinc metal satisfies these conditions, and large yields of pure uranium trichloride were obtained by

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EXPERIMENTAL

The apparatus was essentially an all glass vacuum sublimation still with a controlled temperature gradient maintained in the condenser, so that vapors were fractionally condensed. The metals were placed at a position adjacent to the charge of uranium tetrachloride. The tetrachloride vapors passed over the hot metal at 450-480°C. The excess tetrachloride vapors, as well as the volatile reaction products were fractionally condensed for identification, and the yield of uranium trichloride and weight loss of metal were determined.

Sixty two grams of zinc metal and ninety seven grams of uranium tetrachloride were charged in a typical experiment. After eighteen hours all the zinc and thirteen grams of uranium tetrachloride had sublimed from the charge section. The quantity of uranium trichloride produced, 10.2 grams, represents 86% conversion of the tetrachloride vapors. This uranium trichloride analyzed 69.3% U, 30.8% Cl, 0.18% Zn. Theoretical analysis is 69.1% U, 30.9% Cl.

SUMMARY

Good quality uranium trichloride can be prepared by reduction of uranium tetrachloride vapors by metallic zinc. Zinc and its chloride sublime readily, continually exposing new surface for reaction, and zinc chloride is so volatile that it does not appreciably contaminate the uranium trichloride produced.

REFERENCES

- (1) Young, H. S., Wagner, E. L., and A. J. Miller, CEN-TEC Report C-2.350.5, (Nov. 23, 1945).