

## THE ATOMIC WEIGHT OF INDIUM.

[PRELIMINARY NOTE.]

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THE publication of a preliminary note by A. Thiel<sup>1</sup> upon "The Atomic Weight and Some New Compounds of Indium" leads the authors to describe briefly the results of an investigation, begun some months ago and not yet completed, upon the same subject.

The indium used in our work was purchased on the market in the metallic form. In studying methods for its purification for the atomic weight determinations that are now being carried forward the following observations have been made:

Iron can be separated from indium by adding potassium sulphocyanate to a slightly acid solution of the chlorides of the two metals, and separating the ferric sulphocyanate by shaking up this aqueous solution with ether. The removal of iron by this method is complete, but the ether solution of the ferric sulphocyanate contains traces of indium.

Anhydrous ferric chloride and anhydrous aluminum chloride in alcoholic solutions give no precipitate with pyridine. Anhydrous indium chloride in alcoholic solution gives with pyridine a heavy white precipitate. This precipitate is soluble in a rather large excess of pyridine, is difficultly soluble in absolute alcohol, and difficultly soluble in ether. It is changed by water to the flocculent indium hydroxide. This change is facilitated by warming the precipitate. Commercial indium, when dissolved in hydrochloric acid, evaporated to dryness on the water-bath, and taken up with absolute alcohol, gave, with pyridine, this white precipitate which, when tested with potassium sulphocyanate, showed no iron, although the solution from which the indium was precipitated reacted strongly for iron.

An aqueous solution of hydroxylamine precipitates gelatinous indium hydroxide. In the presence of hydroxylamine hydrochloride, hydroxylamine produces no precipitate.

The ordinary yellow indium oxide is reduced by dry ammonia

<sup>1</sup> *Ber. d. chem. Ges.*, 37, 175 (1904).

gas at a temperature of between 200° and 300° with, however, some volatilization, as observed by Thiel.

Anhydrous indium chloride when volatilized in a current of dry ammonia gas forms a white, crystalline, volatile addition-product.

Metallic indium is easily precipitated by electrolysis from chloride or sulphate solutions in the presence of pyridine, hydroxylamine, or formic acid. Indium does not separate satisfactorily from solutions containing oxalic acid or oxalates. From acetate solutions the deposit is rather gray in color and tends to be spongy. From a solution of indium chloride containing pyridine, metallic indium deposited on the cathode as a brilliant, whitish, compact coating. This deposit, when dissolved in hydrochloric acid, showed no iron even when iron was present in the original solution that was electrolyzed. From solutions containing hydroxylamine hydrochloride and hydroxylamine in slight excess, a brilliant compact deposit was obtained.

The best results, however, were obtained by observing the following conditions: Yellow indium oxide was dissolved on the water-bath in 6 N sulphuric acid, with careful avoidance of an excess of the acid. To this solution 25 cc. of formic acid (sp. gr. 1.20) and 5 cc. of ammonium hydroxide (sp. gr. 0.908) were added, and the whole diluted to 200 cc. The current density employed varied from  $N.D_{100} = 9-12$  amperes, the amounts of metal precipitated in the different experiments varying from 0.2 to 1.5 grams. The indium was deposited upon a rotating cathode, a Classen dish, and also upon small platinum strips. All of these methods of procedure gave equally good results. Using the above-described solution, platinum black was not formed, the cathodes remaining perfectly bright after the metal was dissolved off. Under the microscope the deposit is brilliant, compact, and microscopically crystalline. Apparently it is not acted upon by the air. The platinum cathode was never attacked during the electrolyses if the solution contained formic acid, but in the absence of this substance very small amounts of platinum black were formed whenever a solution of the chloride was electrolyzed.

Indium nitrate crystallizes from aqueous solutions in the presence of ammonium nitrate and separates in the form of a white, beautifully crystalline ammonium indium nitrate.