

rapid, the respective chlorides subliming and condensing in the cooler portion of the tube beyond.

The metals used in these experiments were not specially purified, but were such as are furnished by the best German manufacturers as pure.

CHEMICAL LABORATORY,
VANDERBILT UNIVERSITY, JULY, 1893.

THE ELECTRO-DEPOSITION OF IRIIDIUM; A METHOD OF MAINTAINING THE UNIFORM COMPOSITION OF AN ELECTROPLATING BATH WITHOUT THE USE OF AN ANODE.¹

BY WM. L. DUDLEY.

IN 1884 while engaged in studying the metallurgy of iridium from a commercial standpoint, I made many experiments in order to obtain a satisfactory bath for the electro-deposition of the metal. From a practical standpoint many difficulties were encountered, while experimentally most solutions of iridium yield the metal very readily under the influence of the electric current.

Much experimenting was done with the hope that a method might be devised by which a solution of the metal could be obtained electrolytically, thus avoiding the tedious and expensive processes for dissolving the platinum metals, but without success. Many electrolytes were employed under all conceivable conditions with iridium anodes in various forms, especially plates made by fusing iridium with phosphorus, but nothing practical was obtained. The iridium solutions were therefore made by several of the well known methods.

The next problem to be solved was to keep the solution of constant metallic strength and purity. Every electro-metallurgist knows that a plating bath must remain constant in composition, and that the slightest change in any particular will impair its

¹ Read before the American Association for the Advancement of Science, Madison Meeting, August, 1893.

working qualities when once the conditions for the best results have been attained. Ordinarily the uniform composition of the bath is maintained by using an anode of the pure metal which is being deposited. In the case of iridium this method of enriching the bath was hopeless, judging from previous experiment.

It was soon apparent that an iridium bath could be maintained of uniform metallic strength and composition in two ways only—(1) by an oxide and (2) by a hydroxide; and further, that the oxide or hydroxide used must be insoluble in the electrolyte but readily soluble in the acid radicle set free at the anode. Thus this part of the problem was solved and for various reasons the iridic hydrate, $\text{Ir}(\text{OH})_3$ was employed. The precipitated hydrate could be suspended in the bath at intervals by stirring, and the excess be allowed to settle before using; the liberated acid would thus be neutralized. But in practice it was found best to use carbon plates as anodes and to surround each plate with a loose fitting linen bag containing the $\text{Ir}(\text{OH})_3$. By this means the acid is neutralized soon after liberation and before it can diffuse through the solution. Thus the bath is kept uniform and clear. Bags containing the hydrate can be hung into the solution at other points if found desirable.

Various salts were found to give very good results, and I may mention the sodium iridichloride, the ammonium iridichloride, and a solution made by dissolving the hydrate in sulphuric acid and adding ammonium sulphate.

Like all hard and brittle metals the electro deposit has a tendency to blister and considerable care in the regulation of the current-strength is necessary.

At the time this work was being carried on, it was thought that the plan of using the hydrate to keep up the metallic strength of a plating bath would find wider application, and be useful in solving the problem of aluminum plating should a suitable bath for the deposition of that metal be discovered. The cheap production of the metal, however, has solved this problem independently.

In May, 1890, my friend Dr. Wm. H. Wahl, secretary of the Franklin Institute, wrote, saying that he was revising his work on "Galvano-Plastic Manipulation," and asking me to furnish

him some details of the iridium plating process. I sent him an outline of the method, describing the use of the iridium hydrate in lieu of a soluble anode. He replied at once that I anticipated him inasmuch as he had just worked out the same plan to solve the platinum plating problem after a year of hard labor. It was a source of great regret to us both for in neither case had the method been devised without much thought and labor, although it is so simple. Dr. Wahl read his paper on platinum plating before the chemical section of the Franklin Institute, on May 20, 1890, in which he made generous mention of my work. I regret that I could not have saved him so much labor; but owing to my relations to the corporation for which I was making the investigations, I have been unable to publish the results sooner.

CHEMICAL LABORATORY,
VANDERBILT UNIVERSITY.

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ALUMINUM.

BY R. L. PACKARD.

(Continued from page 236.)

Metallurgical use.—The quantity of aluminum used in this country in the manufacture of iron and steel castings is probably from twenty-five to thirty per cent. of the total production. In Europe it is estimated by Professor Wedding to be fifty-four per cent. This use, as was explained in the last number of this series, consists in adding from 0.10–0.15 per cent. of aluminum to iron or steel just before casting, by which blow-holes are prevented and sounder castings are produced. This use is becoming general. The beneficial effect, as was shown by experiments referred to last year, is due in part at least to the deoxidizing action of aluminum upon carbon monoxide at a high temperature, a reaction which was demonstrated directly between the metal and the gas. This subject has not yet received an exhaustive examination. For this purpose it would be necessary to know the composition of the iron or steel operated on in each case and make comparative tests on the different specimens. It is also probable that the method of melting employed has an effect on the result.