The Crystal of Zinc coating the Surface of Iron Plate

By

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Abstract

The writer examined the zinc crystal deposited on the surface of iron plate roentgenographically, to see whether it consisted of a zinc single crystal or whether it had some other special structure; and it was found that the zinc crystal deposited on the surface of iron plate, consisted of a single crystal of zinc, and that the basal plane (0001) of the hexagonal closed packed zinc crystal was inclined to the surface of the iron plate at an angle of about 18°.

The orientation of single crystals of zinc, formed under various conditions, has been investigated by K. Tanaka[1], but the orientation of the zinc crystal deposited on the surface of iron plate has not yet been examined.

In this investigation, the writer examined the following three kinds of specimens: (1) the zinc crystal formed on the surface of an iron plate of about 4.5 mms. in thicknesss, (2) the portion of the zinc crystal formed in the region beyond the edge of the iron plate, and (3) the iron plate itself on whose surface the zinc crystal was deposited. These test pieces were examined by taking the X-ray diffraction patterns.

The determination of the orientation of the crystal by means of the Laue-photograph was much faciliated by the use of the crystallographic globe devised by Prof. U. Yoshida[2].

1. K. Tanaka, These Memoirs, **11**, 361. (1928)
2. U. Yoshida, Japanese J. Phys. **4**, 133 (1927); S. Takeyama, These Memoirs, **12**, 257 (1929)

There are four methods for plating iron plate with zinc: the hot dipping, electro-galvanizing, spheradizing and metal spraying processes. As the first of these four methods, is the one generally used, it was also used in this experiment.

A piece of commercial zinc was melted in a crucible. Small pieces of commercial iron plate coated with zinc, 2—4 cms. in width and 4 cms. in length, were dipped into the molten zinc metal. Before they were dipped into it, their surfaces were cleaned with dilute sulphuric acid. The reason why the writer used commercial iron plate coated with zinc instead of iron plate itself is as follows. With an iron plate, the cleaning of its surface is very troublesome, but when an iron plate coated with zinc is dipped into molten zinc, the zinc film on the surface of the iron plate is immediately removed by being melted into it. Thus the deposit of zinc, which is formed on the surface of the plate when it is taken out of the melt, is considered to be formed on the surface of the iron plate, and not on the surface of the thin film of zinc which has coated the iron plate. So the trouble of cleaning the surface of the iron plate is avoided by this method.

The size of the crystals of zinc formed on the iron plate depends upon the cooling conditions. In general, when the plate is cooled slowly by using a large piece of it, we get large size crystals; but when it is cooled rapidly by using a small piece of it, small crystals appear on the surface of the plate.

When the plate was taken out of the molten zinc, the arrangement of the zinc crystals on the surface of the plate could not be seen clearly by the naked eye, so the surface of the plate coated with zinc was etched slightly with dilute sulphuric acid.

In order to examine, with X-rays, the crystals of zinc deposited on the surface of the iron plate in the manner described above, we must separate the zinc film on one side of the plate from the remaining part of the plate. To do this one side of the plate was covered with paraffin, and the remaining part of the plate was etched off with dilute hydrochloric acid. However the zinc film was so thin in our case, that it was very difficult to etch off the iron core completely from the zinc film.

To get over this difficulty, the method of preparing the specimens was slightly modified. An iron plate coated with zinc was dipped into the molten zinc, and when it was lifted slowly in the vertical direction from the molten zinc, a tongue-shaped part of zinc was formed

at the lower edge of the iron plate. This part of zinc was confirmed, by taking Laue-photographs, to belong to the same single crystal of zinc as that covering the lower part of the iron plate. The Laue-photograph reproduced in Fig. 2 of the plate is taken with the zinc crystal forming the tongue-shaped part at the lower edge of the iron plate as is stated above. Fig. 3 in the plate is the Laue-photograph taken with the iron core, prepared by etching off the zinc coatings on both sides of the plate; and Fig. 1 in the same plate is the Laue-photograph of the iron plate coated with zinc on one side, obtained by etching off the zinc-coating on the other side of the plate. By comparing the photographs in Figs. 1 and 3 in the plate, we can select the Laue-spots due to the zinc crystals in Fig. 1 of the plate. And the comparison and the determination of the orientations of the zinc-crystals in the cases of Figs. 1 and 2 in the plate are thus performed promptly by the aid of the crystallographic globe.

Table

No. of specimen	Angle between the surface of the iron plate and the crystal face (0001)
1	18°
2	18°
3	18°
4	18°

The orientation of the zinc crystals coating the iron plate, which is determined in the manner described above, is given in the Table. From this Table we know that the hexagonal zinc crystals coating the iron plate have such an orientation that their (0001)-plane is inclined to the surface of the iron plate at an angle of about 18°.

In conclusion, the writer wishes to express his sincere thanks to Prof. U. Yoshida, of Kyoto Imperial University for his guidance in the research.

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Plate

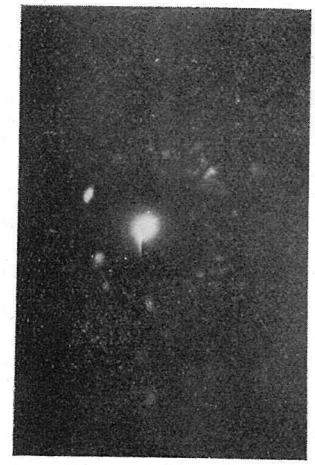

Fig. 1

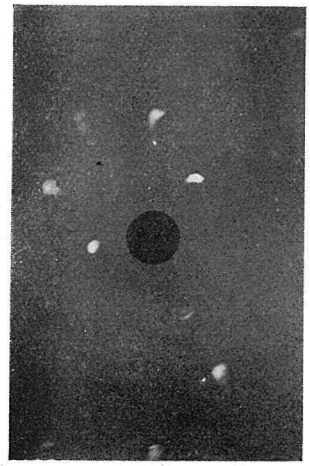

Fig. 2

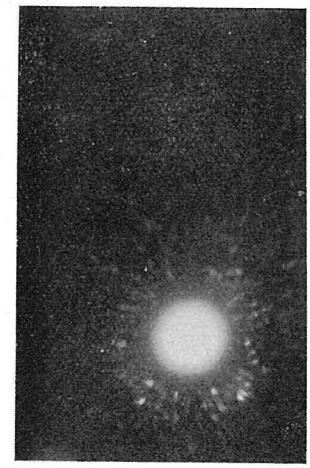

Fig. 3