

## THE VOLATILIZATION OF SILICA AND ZIRCONIA AND THE REDUCTION OF THESE SUBSTANCES BY CARBON.

By HENRI MOISSAN.

ON submitting zirconia to the high temperature of the electric furnace, this oxide quickly enters into fusion. After the lapse of ten minutes, on operating with a current of 360 amperes and 70 volts, there appear very abundant white fumes. These fumes consist of the vapor of zirconia, which earth at this high temperature is in full ebullition. If the vapors are condensed upon a cold substance, we obtain a white powder, which is treated with very dilute hydrochloric acid to remove any lime present. After washing with boiling distilled water and desiccation there remains a white powder, which under the microscope appears as white rounded masses, without any transparent particles. This powder presents all the characters of zirconia. It scratches glass with ease, and its sp. gr. is 5.10.

After cooling, there remains in the crucible a mass of melted zirconia, with a crystalline fracture. Within the furnace, in the cooler parts, we sometimes find characteristic crystals of zirconia, of the form of transparent dendrites, of a vitreous luster, not attacked by sulphuric acid, and capable of scratching glass.

This zirconia, when in fusion, is easily reduced by coke. If we place a quantity of zircon in a crucible of coke, we find below the residue of melted zirconia a metallic regulus of zirconium, containing neither carbon nor nitrogen, but containing variable quantities of zirconia.

On the contrary, on mixing zirconia with an excess of coke, we obtain a substance of a metallic appearance, not containing nitrogen, and which on analysis gave the following results:

	1	2	3
Carbon.....	4.22	4.60	5.10

When the zirconium carbide is richer in carbon, it is rapidly destroyed on exposure to the air.

This carbide may be refined so as to yield metallic zirconium by remelting in presence of an excess of liquid zirconia. Zirconium is a very hard body, which easily scratches glass and ruby. Its sp. gr. is 4.25. It therefore approximates very closely to that of Troost's zirconium (4.15).

**Silica.**—Fragments of rock crystal in a crucible of coke were exposed to the action of the electric arc produced by a current of 350 amperes and 70 volts. In a few moments the silica enters into fusion, and in seven or eight minutes ebullition sets in.

There then issues from the furnace, by the apertures which give passage to the electrodes, a smoke of a bluish color, lighter than that produced by zirconia. These vapors are given off plentifully as long as the experiment continues. They may be condensed by placing an inverted crystallizer at some distance from the apertures of the furnace. The interior of this crystallizer is rapidly coated with a slight layer of a scarcely transparent substance, of a slightly bluish white color. On taking up the contents of the crystallizer in water, and examining this residue under the microscope with a very low power, we see that it is chiefly formed of opalescent spheres, quickly soluble in hydrofluoric acid. These small spheres of silica visible to the naked eye are solid. They sometimes present at one point a hollow, which seems to indicate that the melted silica has contracted in volume in passing from the liquid to the solid state. Along with these spheres there are numerous particles of amorphous silica.

If we wish to collect a notable quantity of this product, it is better to use a furnace the cover of which has an aperture for the escape of the vapor of silica. A glass bell is placed over this aperture, and we may thus, in from ten to fifteen minutes, collect 20 grms. of a very light white powder, which is purified from lime by washing with dilute hydrochloric acid.

The form of the condensed silica depends of course on the more or less rapid refrigeration of the vapor. This process must not be too rapid if we wish to obtain numerous spherules of silica.

This silica is very soluble in hydrofluoric acid. It dissolves in the cold with a slight rustling noise. It is readily attacked by melting potassium hydrate and by alkaline carbonates. Its sp. gr. is 2.4, i. e., a little lower than that of rock crystal. The spherules scratch glass with ease.

On studying the deposit formed in glass globes in which the electric arc has been caused to play for lighting, we have found small globules of silica identical with those just described. The opalescence of glass globes in which the arc has been in action for some time is therefore due to the volatilization of silica. This silica is derived from the impurities of the electric carbons.

We will add that silica at this temperature is easily reduced by carbon, and yields a crystalline silicon carbide which we are further examining.—*Comptes Rendus*, cxvi, p. 1222; *Chem. News*.

## A STUDY OF LIGHT SOURCES BY PHOTOGRAPHY.

In a recent issue of *Nature*, reference was made to the photographic study of sources of light by means of a carefully graduated series of exposures, which was first applied with great success by M. Janssen to the investigation of the minute structure of the solar surface.

M. Crova has now applied a similar method to the study of the Carcel standard and the electric arc. A contrast between the various parts of the magnified photographic image of the Carcel flame does not appear until the exposure is reduced to the minimum necessary to secure an impression; and to bring out this contrast, the negative must be developed slowly and subsequently intensified. Four photographs thus obtained were exhibited at a recent meeting of the French Academy. The axis of the flame appears dark, and the zone of combustion exhibits two bright lines representing the external and internal surfaces of combustion of the hydrocarbons, with a dark line between them corresponding to the space where combustion is incomplete. Photographs of the flames of a candle, an amylacetate lamp, and a batwing gas jet were also exhibited, showing analogous phenomena. The same

method applied to the arc light yielded some very interesting results. As the time of exposure was reduced, the arc gradually vanished; the negative carbon was reduced to a very small surface, and the positive carbon exhibited a surface riddled with dark spots, and granulated like the surface of the sun in M. Janssen's photographs. These granulations could be seen in violent motion on the ground glass screen of a camera with the lens sufficiently stopped down. It follows that it is not admissible to screen off all but a very small portion of the luminous source, in order to reduce the amount of light in the same proportion as the area of luminous surface. With very small surface elements, both the amount of light and the temperature, and hence also the tint of the light, may be constantly changing.

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