THE APPLICATION OF ALLOTROPIC SILVER FOR THE PREPARATION OF CONDUCTING FIBERS.

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A NUMBER of articles discussing allotropic modifications of silver have appeared in the various journals since 1889. These articles treat rather of the methods of preparation and physical condition of the different allotropic modifications, than of any application of them. A complete list of references is given by Barus and Schneider.[1]

Three forms of allotropic silver are described, all of which have certain properties common to themselves and which distinguish them from ordinary silver.

When a suspension or emulsion of any of these forms of allotropic silver is spread over paper and dried, the particles are left in optical contact and thus form an apparently continuous film.

Treatment with halogens produces brilliant interference color effects. All the forms are very readily changed to an impalpable powder. Treatment with acids instantly changes all forms to ordinary silver, with apparently no chemical action. No gas is evolved.

It is the purpose of this article to give a simple and efficient means for the preparation of conducting fibers; whether they be used for suspension, as in the quadrant electrometer, or otherwise; and whether the fiber material be quartz or any other suitable substance.

The allotropic silver used was prepared according to the process described by Carey Lea.[2]

A mixture of 200 c.c. of a 30 per cent. solution of ferrous sulphate and 280 c.c. of a 40 per cent. solution of sodium citrate was treated with a 10 per cent. solution of sodium hydroxide, just till no permanent precipitate formed. This was then mixed with 200 c.c. of a 10 per cent. silver nitrate solution stirred thoroughly, allowed to

[1] Wied. Ann., XLVIII., p. 327, 1893.
[2] Am. Jour. Sci., XXXVII., p. 476, 1889.

settle and the liquid decanted. The precipitated allotropic silver was treated with about 200 c.c. of distilled water, which dissolved a part of it, and was again precipitated by treatment with a saturated solution of ammonium nitrate. This process was repeated three times, and the final precipitate filtered with suction and washed with 95 per cent. alcohol. The product was transferred, in the form of a brown mud, to a bottle and kept covered with alcohol.

The allotropic silver was used for the experiments as an emulsion in alcohol, alcohol being used rather than water as it dries more quickly and thus the dry film of allotropic silver can be obtained in a very few minutes after spreading the emulsion.

This emulsion spread on any surface and dried gave a copper-colored film. When dried on a glass plate and viewed through the glass, it gave a good mirror, but of a dark color.

When these films were treated with gaseous hydrochloric acid they were immediately changed to ordinary silver and presented a dull silvery appearance. The films are changed to a bright silver surface by slight friction. It was the action of the gaseous hydrochloric acid, which suggested the investigation.

Glass plates were painted with the emulsion and dried. The conductivity of the films in this condition was found to be very poor. It was tested by placing the terminals of an ordinary dry battery upon the films with an ammeter in circuit. The electromotive force of the battery was about two volts and the terminals were placed eight or ten centimeters apart.

The films were then treated with gaseous hydrochloric acid by blowing through an arrangement like a reversed wash-bottle, the bottle containing a little strong hydrochloric acid. By this means a stream of gaseous hydrochloric acid was very readily directed upon the allotropic silver films, thus changing them to sheets of ordinary silver. These films were then tried with a battery as before and found to be excellent conductors.

The use of the silver was then tried on the quartz film of a quadrant electrometer as follows: The quartz fiber, suspending the aluminium needle between the hollow quadrants, was hung from a hook which was thoroughly insulated with hard rubber. The

whole was enclosed in a copper case to prevent disturbance by air currents and a beam of light reflected through a glass window in the copper case, from a mirror fixed on the needle, served as a pointer on a transparent scale arranged at the proper distance.

The instrument having been adjusted, experiments were tried to see how quickly the needle responded on being charged. It was found to respond instantaneously.

Various tests on the electrometer with the fiber prepared as above stated were perfectly satisfactory.

CONCLUSIONS.

The dried films of allotropic silver, although poor conductors, become very good conductors on treatment with gaseous hydrochloric acid.

The emulsion can be used admirably for the preparation of conducting fibers; and can be applied to the most delicate apparatus in a very few minutes, without danger of injury.

The above work was done in the physics laboratory of Brown University. In closing, the writer wishes to express his thanks to Professor Carl Barus, for his valuable instruction and friendly aid.